BULLETIN

OF THE

ESSEX INSTITUTE,

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ESSEX INSTITUTE.

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PREFATORY NOTE.

At a meeting of the Essex Institute, held on Monday, December 17, 1883, it was announced that the Friday evening preceding (Dec. 14) was the fiftieth anniversary of the assembling together of a few friends, among whom may be mentioned Dr. Andrew Nichols of Danvers, William Oakes of Ipswich, John C. Lee, Thomas Spencer, J. M. Ives, B. H. Ives, Charles G. Page and others, of Salem, to take the initiatory steps in the organization of a society for the promotion of Natural History, under the name of the Essex County Natural History Society. At this meeting a committee was appointed to draft a constitution and by-laws, and these were adopted at an adjourned meeting held on the Wednesday following.

The completion of the organization was effected at a meeting held in Topsfield on Wednesday, April 16, 1834. This last event it is proposed to commemorate in April next at Topsfield.

This Society united with the Essex Historical Society, organized in 1821, was incorporated by the Legislature of 1848 under the name of the Essex Institute.

The following publications may be specified among those issued by the Institute since its organization in 1848.

Proceedings and *Communications* 6 vols., 8vo, 1848 to 1868. These volumes contain a large number of descriptions and figures of new species, especially of corals, insects and polyzoa, and many valuable papers in natural history. The first three volumes also contain many important historical papers. In addition to the papers on special subjects, these volumes contain the proceedings of the meetings of the Institute, the records of additions to the Library and Museum, and many important verbal communications made at the meetings.

Bulletin 15 vols., 8vo, issued quarterly, a continuation of the "Proceedings of the Essex Institute" containing an account of the Regular Home and Field Meetings of the Society and papers of scientific value.

Historical Collections 20 vols., 8vo, issued quarterly, contain extracts from the records of courts, parishes, churches and towns in this county; abstracts of wills, deeds and journals; records of births, baptisms, marriages and deaths, and inscriptions on tombstones; also papers of historical, genealogical and biographical interest. In these volumes will be found memoirs of deceased members of the Institute and others; also genealogies of Essex County families.

Flora of Essex Co., by John Robinson, 8vo, pp. 200.

First Cruise of Frigate "Essex," by Admiral Geo. H. Preble, U. S. N.

In the year 1883 the Institute exchanged publications with thirty-two societies in Germany, ten in France, four in Switzerland, three in Austria, one in Denmark, four in Sweden, two in Italy, two in Belgium, thirteen in Great Britain (besides receiving the Government Surveys of India and the United Kingdom), and with eighteen Miscellaneous, twenty-three Scientific and twenty-three Historical Societies in America.

THE NORTH AMERICAN REPTILES AND BATRACHIANS.

A LIST OF THE SPECIES OCCURRING NORTH OF THE ISTHMUS OF TEHUANTEPEC, WITH REFERENCES.

BY SAMUEL GARMAN.

The following list is presented in the shape in which it has proved most useful in my own work. As in other publications, I have placed the date immediately after the authority, as one naturally thinks it. In order accurately to determine species, comparison should be made with the original description rather than with the opinion of a subsequent writer; for this reason reference is made to the discoverer and not to one in whose opinion the species belongs to a genus some other than that in which it was originally placed. Consequently, the references are under names unaffected by frequent changes from one genus to another.

Heretofore, the faunal limit for North America has been patriotically placed at the Mexican boundary. The distribution of the reptiles and Batrachians proves this limit to be unscientific, and shows the nearest approach to a separation between the faunæ of the Americas, North and South, at the southern extremity of the tableland of Mexico. Attempt is made in this list to include all the species known to occur north of that point.

When several localities for a species are given, they are chosen to indicate the extent of its range as nearly as possible.

With a slight modification, the binomial system is followed. For various reasons, as will be seen below, the tri-

or polynomials affected by different authors, can hardly be considered improvements. Such names as, for example, *Cinosternum* (*Thyrosternum*) *pennsylvanicum pennsylvanicum* (v) x, or *Tropidonotus* (*Nerodia*) *compressicaudus compressicaudus flavirostris* (v) y, if there were varieties, have the appearance of doubtful advances from a binomial system. According to that system, if V first describes a species under a certain title, and W discovers one closely allied —giving it a name—and X says W's species is not sufficiently distinct, X is entitled to the credit rather than W, and the formula reads *Genus* (*Subgenus*) *species subspecies* (V) X. That is, V is credited with a form he never saw, and W is discredited by X who claims to rank with V because, for whatever reason, possibly insufficient knowledge, he arrives at a conclusion differing from that of W. If there are varieties, Y may displace X, and for authorities we should have (V) Y, or, if Z discovers that Y's variety is out of place, (V) Z, and in either case the authorities cited may give us no information concerning the form to which the names refer.

If we are now to adopt a polynomial system, we might, to be more consistent, accept the names given before Linné's time.

The modification suggested in the binomials consists in using a symbol, a letter, to represent each form or race of a species with its history or synonymy. To illustrate, *Eutænia sirtalis* Linn.; B. & G., is the first (A) of a group of forms of the species *sirtalis*, Linné being authority for the species, and Baird and Girard for its position in the genus. The A can always be understood and need not be written with the first described form. If either the symbol or the name following it is in italics there can be no confusion.

B *Eutæniæ sirtalis* is the form to which Catesby gave the name *Vipera gracilis maculatus*, afterward named by

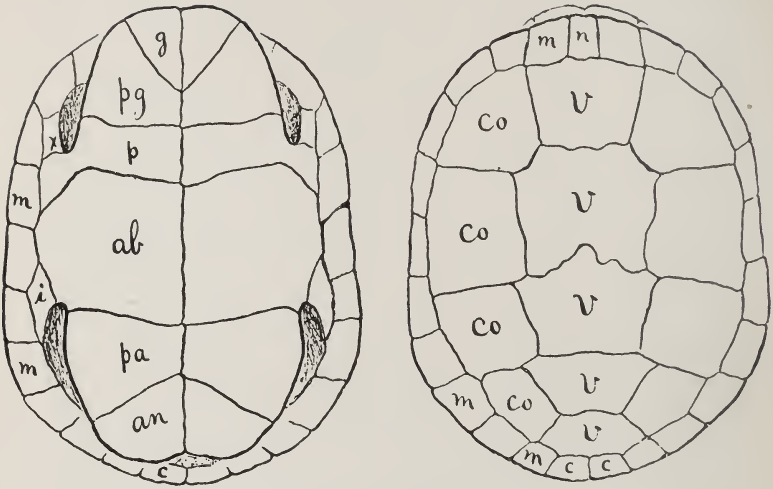
Linné *Coluber ordinatus.* The authorities for the races succeeding the first may or may not be written. To write them, D *E. sirtalis* Say; Jan, is that described by Say as *Coluber parietalis*, but placed as a variety of *sirtalis* by Jan. In the synonymy, the history of each of the various forms is indicated under their respective letters. The use of the letter leaves little or no excuse for duplication, confusion, and excessive length in the name, or for a questionable disregard of the earlier authorities. It may be objected that the original name tells more about the form than would a symbol. If we grant this in cases in which the name fixes some obvious characteristic of the species, there remain all those in which such names as *Smithi*, *Doubledayi*, *Wosnessenskyi*, and similar ones have been employed, many others in which the history of the form begins under a vernacular, or, if a variety noted by Gray, Günther, Bibron, Boulenger and other writers, under a letter, and a multitude of cases of names emphasizing some peculiarity — individual, sexual, or belonging to certain seasons or ages, which not being permanent or general are inaccurate or misleading.

It is suggested that the names are easier to learn or remember than the letters. Why the name Smithi should be easier than D or H does not appear; neither does it appear that a large number of letters, as in the long names, is easier to learn or remember than a single one.

Letters are in use among English and French writers to indicate varieties, the custom dating back half a century or more.

The method suggested has been applied in a few of the following genera. There are numerous others in which the present list of species, as in *Sceloporus*, *Geotriton*, and others, is susceptible of a considerable reduction, which will be a necessary consequence of further study.

TESTUDINATA.



CHRYSEMYS PICTA.

g. Gular.
pg. Postgular.
p. Pectoral.
ab. Abdominal.
pa. Preanal.
an. Anal.
x. Axillary.
i. Inguinal.
n. Nuchal.
m–m. Eleven Marginals.
co. Four Costals.
c. Caudal.
v–v. Five Vertebrals.

SPHARGIDIDAE.

DERMATOCHELYS Blainv., 1816, Bull. Soc. Philom., p. 111.
Testudo coriacea (Rond.) Linn., 1766, Syst., Ed. 12, 350.
Tropical Atlantic and adjacent waters.
D. schlegeli
Tropical Pacific and Indian oceans.

CHELONIOIDAE.

THALASSOCHELYS Fitz., 1836, Ann. Mus. Wien, I, 121.
Testudo cephalo Schneid., 1783, Schildkr., 303 (*caouana* auct.).
Tropical Atlantic and adjacent waters.

Chelonia olivacea Eschsch., 1829, Zool. Atlas, p. 3, pl. 3.
Tropical Pacific and Indian oceans.

COLPOCHELYS Garman, 1880, Bull. Mus. Comp. Zool., 124.
C. kempi Grmn., l. c. 123.
Northeastern part of the Gulf of Mexico.

ERETMOCHELYS Fitz., 1843, Syst. Rept., 30.
Testudo imbricata Linn., 1766, Syst., 350.
Tropical Atlantic and adjacent waters.
Caretta squamata Krefft, 1871, Austral. Vertebr., 39.
Tropical Pacific and Indian oceans.

CHELONIA Brongn., 1805, Essai d'une Class. Rept.
Testudo mydas Linn., 1758, Syst., 197.
Tropical Atlantic and adjacent waters.
(B) **Chelonia marmorata** D. & B., 1835, Erp., II, 546.
Atlantic around Ascension Island.
Chelonia agassizii Bocourt, 1870, Miss. Sci. Mex., Rept., p. 26, pl. 6.
Tropical part of the eastern Pacific.

TRIONYCHIDAE.

AMYDA Fitz., 1843, Syn. Rept., 30.
Trionyx muticus Les., 1827, Mem. Mus., XV, 263.

PLATYPELTIS Fitz., 1836, Ann. Wien Mus.
Testudo ferox Penn., 1767, Phil. Trans., LVI.
Mississippi valley and eastward.

ASPIDONECTES Wagl., 1830, Amph., 134.
Trionyx spiniferus Les., 1827, Mem. Mus., XV, 258.
Mississippi river, tributaries and eastward.
A. asper Ag., 1857, Contr., I, 405.
Valley of the lower Mississippi.
A. nuchalis Ag., l. c., 406.
Tennessee river and eastward.
A. emoryi Ag., l. c., 407.
Texas to Mexico.

CHELYDROIDAE.

CHELYDRA Schweigg., 1814 (read 1809), Prodr. Monogr. Chelon., 23.

Testudo serpentina Linn., 1754, Mus. Ad. Fridr., 36,—1758 Syst., 199.

From Canada southward, east of the Rocky mountains.

MACROCLEMYS Gray, 1855, Cat. Sh. Rept., 48.

Chelydra lacertina Schw., 1814, Chelon., 23.

Florida to Texas.

CINOSTERNOIDAE.

AROMOCHELYS Gray, 1855, Cat. Sh. Rept., 46.

Testudo odorata Latr., 1801, Rept., I, 122.

Maine to Texas.

GONIOCHELYS Ag., 1857, Contr., I, 423.

Aromochelys carinata Gray, 1855, Cat. Sh. Rept., 47.

Florida to Texas.

G. minor Ag., 1857, l. c., 424.

Alabama to Louisiana.

THYROSTERNUM Ag., 1857, Contr., I, 427.

Testudo pennsylvanica Gmel., 1788, Syst. Linn., I, 1042.

Virginia to Florida.

Cinosternum sonoriense LeC., 1854, Pr. Phil. Ac., 184.

Arizona; Sonora.

C. integrum LeC., l. c., 183.

Mexico.

C. henrici LeC., l. c., 182.

Arizona.

C. doubledayi Gray, 1844, Cat. Tort., 33.

California.

C. cruentatum Dum., 1851, Cat. Met., 16.

Mexico; Texas.

K. punctatum Gray, 1855, Cat. Sh. Rept., 45 (s. d.).

Eastern Florida.

K. shavianum Bell., 1825, Zool. Jour., II, 304.

PLATYTHYRA Ag., 1857, Contr., I, 429.

P. flavescens Ag., l. c., 430.

California; Texas; Utah.

EMYDOIDAE.

PSEUDEMYS Gray, 1855, Cat. Sh. Rept., 33.
Testudo rugosa Shaw, 1802, Zool., III, 28.
New Jersey; North Carolina.
T. concinna LeC., 1820, Ann. N. Y. Lyc., 106.
North Carolina; Missouri; Louisiana.
Emys mobiliensis Holbr., 1842, Herp., I, 71.
Florida to Mexico.
E. hieroglyphica Holbr., l. c., 111.
Gulf States to Tennessee.
E. ornata Gray, 1831, Syn. Rept., 30.
Mexico.
Callichelys? pulcherrima? Gray, 1863, Ann. Mag., 181.
Mexico.

TRACHEMYS Ag., 1857, Contr., I, 434.
Testudo scabra Linn., 1758, Syst., I, 193.
North Carolina to Georgia.
Emys troostii Holbr., 1842, Herp., I, 123.
Illinois and southward.
E. elegans Wied., 1839, Reise N. Amer., I, 176, 213.
Dakota to Texas.

GRAPTEMYS Ag., 1857, Contr., I, 436.
Testudo geographica Les., Jour. Phil. Ac., I, 85, pl. 5.
New York to Texas.
Emys lesueurii Gray, 1831, Syn. Rept., 12.

MALACOCLEMMYS Gray, 1844, Cat. Tort., 28.
Testudo palustris Gmel., 1788, Syst. Linn., I, 1041.
New York to Texas.

CHRYSEMYS Gray, 1844, Cat. Tort., 27.
Testudo picta (Herrm.) Schneid., 1783, Schildkr., 348.
Nova Scotia to Louisiana.
C. marginata Ag., 1857, Contr., I, 439.
Michigan to Iowa.
C. dorsalis Ag., l. c., 441.
Mississippi to Louisiana.
Emys belli Gray, 1831, Syn., 12.
Illinois to Missouri.
E. oregonensis Harl., 1837, Am. Jour. Sc., 382, pl. 31.
Oregon.

DEIROCHELYS Ag., 1857, Contr., I, 441.
Testudo reticulata (Bosc.) Daud., 1805, Rept., II, 144.
North Carolina to Louisiana.

EMYS Brongn., 1803, Mem. des Sav. Étrang.
Testudo melagris Shaw & Nodder, 1793, Nat. Misc., pl. 144.
New England to Wisconsin.

NANEMYS Ag., 1857, Contr., I, 442.
Testudo guttata Schn., 17—, Berl. Gesellsch. Nat. Fr., IV, pl. 4.
New England to North Carolina.

CALEMYS Ag., 1857, Contr., I, 443.
Testudo muhlenbergii Schoepff, 1792, Test., 132.
Pennsylvania to New Jersey.

GLYPTEMYS Ag., 1857, Contr., I, 443.
Testudo insculpta LeC., 1828–1836, Ann. Lyc. N. Y., III, 112.
Nova Scotia to Kentucky.
Emys incisa Boc., 1870, Miss. Sci. Mex., Rept., 11, pls. 1 and 2.
Mexico.

ACTINEMYS Ag., 1857, l. c., 444.
Emys marmorata B. & G., 1852, Pr. Phil. Ac., 177.
California to Puget sound.

CISTUDO Flem., 1822, Philos. Zool., 270.
Testudo carinata Linn., 1758, Syst., I, 198.
New England; South Carolina; Michigan.
C. triunguis Ag., 1857, Contr., I, 445.
Georgia; Louisiana.
C. ornata Ag., l. c., 445.
Kansas; Dakota.
C. major Ag., l. c., 445.
Alabama; Florida.
Onychotria mexicana Gray, 1849, P. Z. S. Lond., 17.
Mexico.

TESTUDINIDAE.

XEROBATES Ag., 1857, Contr., I, 446.
Testudo carolina Linn., 1758, Syst., 198.
South Carolina; Texas.
X. berlandieri Ag., l. c., 447.
Texas; Mexico.
X. agassizi Cooper, 1863, Pr. Cal. Acad., II, 120.
California; Sonora.

RHIZODONTA.

CROCODILIDAE.

CROCODILUS Gronow, 1756, Mus. Ichth., II, 74,—1763, Zooph., 1, 10.

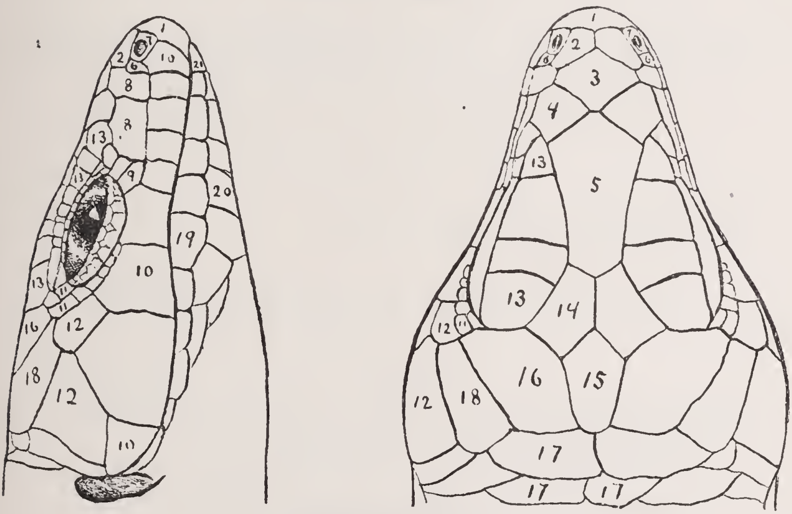
C. acutus Cuv., 1807, Ann. Mus., X, 55.
South America; West Indies; Florida.

C. pacificus Boc., 1870, Miss. Sci. Mex., Rept., 31.
Mexico; Ecuador.

ALLIGATOR Cuv., 1807, Ann. Mus., X.

Crocodilus mississippiensis, Daud., 1805, Rept., II, 412.
North Carolina to Mexico.

SAURIA.



EUMECES FASCIATUS.

1 Rostral.
2 Supranasals.
3 Internasal.
4 Prefrontals.
5 Frontal.
6 Postnasals.
7 Nasals.
8 Loreals.
9 Preorbitals.
10 Labials.
11 Postorbitals.
12 Temporals.
13 Supraciliaries.
14 Frontoparietals.
15 Interparietal.
16 Parietals.
17 Occipitals.
18 Supratemporals.
19 Infralabials.
20 Submentals.

EUBLEPHARIDAE.

COLEONYX Gray, 1845, Ann. Mag., XVI, 162.
Stenodactylus variegatus Bd., 1858, Pr. Phil. Ac., 254.
Texas; California.

GECCONIDAE.

SPHAERODACTYLUS Wagl., 1830, Amphib., 143.
S. notatus Bd., 1858, Pr. Phil. Ac., 254.
Key West, Fla.

PHYLLODACTYLUS Gray, 1829, Spicil. Zool., 3.
P. tuberculosus Wiegm., 1835, Act. Acad. Caes. Leop., XVII, 241, pl. 18, f. 2.
Mexico.
P. xanti Cope, 1863, Pr. Phil. Ac., 102.
Cape St. Lucas.

DIPLODACTYLUS Gray, 1832, Pr. Zool. Soc., 40.
D. unctus Cope, 1863, Pr. Phil. Ac., 102.
Lower California.

HELODERMIDAE.

HELODERMA Wiegm., 1829, Isis, 627.
H. horridum Wiegm., l. c.
Mexico.
H. suspectum Cope (name only) 1875, Checklist, 47.
Utah to Mexico.

TEIIDAE.

CNEMIDOPHORUS Wagl., 1830, Syst. Amph., 154.
Lacerta 6-lineata Linn., 1766, Syst., 364.
Southern States to Colorado.
Ameiva tesselata Say, 1823, Long's Exp., II, 50.
Colorado.
(B) **Cnem. gracilis** B. & G., 1852, Pr. Phil. Ac., 128.
Desert of Colorado.
(C) **C. tigris** B. & G., 1852, Stansbury's Rep., 338.
Texas to California.
(D) **C. melanostethus** Cope, 1863, Pr. Phil. Ac., 104.
California.
C. inornatus B. & G., 1858, Pr. Phil. Ac., 255.
New Leon.

C. octolineatus Bd., 1858, l. c.
New Leon.
C. grahami B. & G., 1852, Pr. Phil. Ac., 128.
Texas to California.
C. maximus Cope, 1863, Pr. Phil. Ac., 104.
Lower California.
C. perplexus B. & G., 1852, l. c.
Texas; New Mexico.
C. mexicanus Pet., 1869, Mb., Brl. Akad., 62, pl. 34.
Mexico.
C. deppii Wiegm., 1834, Herp. Mex., 28.
Colima.
C. guttatus Wiegm., l. c., 29.
Mexico.
C. hyperethra Cope, 1863, Pr. Phil. Ac., 103. (?).
Lower California.

AMEIVA Meyer, 1795, Syn. Rept.
A. undulata Wiegm., 1834, Herp. Mex., 27.
Mexico.
Cnemidoph. praesignis B. & G., 1852, Pr. Phil. Ac., 129.
Acapulco.

ZONURIDAE.

BARISSIA Gray, 1838, Ann. Mag., 390.
Gerrhonotus olivaceus Bd., 1858, Pr. Phil. Ac., 255.
Mexico; California.

GERRHONOTUS Wiegm., 1828, Isis, 379.
Elgaria nobilis B. & G., 1852, Pr. Phil. Ac., 129.
Arizona; Sonora.
G. (Elgaria) kingi (Bell) Gray, 1838, Ann. Mag., 390.
Mexico.
G. deppei Wiegm., 1828, Isis, 379.
Mexico.
G. leiocephalus Wiegm., l. c.
Mexico.
G. imbricatus Wiegm., l. c.
Guanahuato.
G. rudicollis Wiegm., l. c.
Elgaria principis B. & G., 1852, Pr. Phil. Ac., 175.
California.

G. multicarinatus Blainv., 1835, Nouv. Ann. du Mus., 289, pl. 25, f. 2.
California.

Elgaria grandis B. & G., 1852, l. c., 176.
California; Oregon.

G. infernalis Bd., 1858, Pr. Phil. Ac., 255. (?).
Texas.

Tropidolepis scincicaudus Skilton, 1849, Am. Jour. Sci., 202.
California.

XENOSAURUS Pet., 1861, Mb. Brl. Ak., 453.

Cubina grandis Gray, 1856, Ann. Mag., 270.
Vera Cruz.

ANGUIDAE.

OPHEOSAURUS Daud., 1803, Rept., VII, 346.

Anguis ventralis Linn., 1766, Syst., 391.
South Carolina; New Mexico; Illinois.

ANNIELLIDAE.

ANNIELLA Gray, 1852, Ann. Mag., X, 440.

A. pulchra Gray, l. c.
California.

XANTUSIIDAE.

XANTUSIA Bd., 1858, Pr. Phil. Ac., 255.

X. vigilis Bd., l. c.
California.

SCINCIDAE.

OLIGOSOMA Grd., 1857, Pr. Phil. Ac., 196.

Scincus lateralis Say, 1823, Long's Exp., II, 324.
South Carolina; Mexico; Nebraska; Illinois.

EUMECES Wiegm., 1834, Herp. Mex., 36.

Lacerta fasciata Linn., 1758, Syst., I, 209.
Nebraska; Florida; South Carolina; Texas.

Plestiodon obsoletum B. & G., 1852, Pr. Phil. Ac., 129.
Kansas; Mexico.

P. inornatum Bd., 1858, l. c., 256.
Nebraska.

P. skiltonianum B. & G., 1852, Stansbury's Rep., 349.
California.
P. septentrionalis Bd., 1858, Pr. Phil. Ac., 256.
Texas; Minnesota.
P. egregius Bd., l. c.
Florida.
P. tetragrammus Bd., l. c.
Lower Rio Grande.
P. leptogrammus Bd., l. c.
Nebraska.
P. multivirgatus Hallow., 1857, Pr. Phil. Ac., 215.
Texas; Nebraska.
P. anthracinus Bd., 1849, Jour. Phil. Ac., I, 294.
Pennsylvania; Mississippi.
P. longirostris Cope, 1861, Pr. Phil. Ac., 313.
Bermudas.
Mabouia brevirostris Gthr., 1860, Pr. Z. S. Lond., 316.
Oaxaca.
Euprepes lynxe Wiegm., 1834, Herp. Mex., 36.
Guanaxuato.
Lamprosaurus guttulatus Hallow., 1853, Sitgreaves Rep., 113.
Arizona.
Eumeces onocrepis Cope, 1869, Rep. Peab. Ac., 82. (?).
E. hallowelli Boc., 1879, Miss. Sci. Mex., Rept., 435, pl. 22 *e*, f. 7.
California.
E. obtusirostris Boc., 1881, l. c., 441.
Texas.
(?)**Diploglossus millepunctatus** O'Shaug., 1874, Ann. Mag., 301.
N. W. N. America.

IGUANIDAE.

HOLBROOKIA Grd., 1850–51, Pr. A. A. A. S., 201.
H. maculata Grd., l. c.
Texas; Dakota; Sonora.
(B) **H. approximans** Bd., 1858, Pr. Phil. Ac., 253.
Tamaulipas.
(C) **H. propinqua** B. & G., 1852, Pr. Phil. Ac., 126.
Texas.
(D) **H. affinis** B. & G., l. c., 125.
Sonora.
Cophosaurus texanus Trosch., 1850 (1852), Arch. f. Natg. 389, Tab. VI.
Texas.

H. elegans Boc., 1874, Miss. Sci. Mex., Rept., 164, pl. 17 *bis*, f. 8.
Mazatlan.

H. lacerata Cope ?.
Texas.

CALLISAURUS Blainv., 1835, Nouv. Ann. Mus., 286.

C. draconoides Blainv., l. c., 286, pl. 24, f. 2.
(B) **Homalosaurus ventralis** Hallow., 1854, Sitgreaves Rep., 117.

UMA Bd., 1858, Pr. Phil. Ac., 253.

U. notata Bd., l. c.
Arizona.

SAUROMALUS Dum., 1856, Arch. Mus., 535.

S. ater Dum., l. c., 536.
California to Arizona.

CROTAPHYTUS Holbr., 1842, Herp., II, 79.

Agama collaris Say, 1823, Long's Exp., II, 252.
Kansas to New Mexico.

C. wislizenii B. & G., 1852, Stansb. Rep., 340.
California to Texas.

C. reticulatus Bd., 1858, Pr. Phil. Ac., 253.
Texas.

C. copii Yarr., 1882, Pr. U. S. Nat. Mus., 441.
California.

DIPSOSAURUS Hallow., 1854, Pr. Phil. Ac., VII.

Crotaphytus dorsalis B. & G., 1852, Pr. Phil. Ac., 126.
Colorado; California; Sonora.

UTA B. &. G., 1852, Stansb. Rep., 344.

U. ornata B. & G., 1852, Pr. Phil. Ac., 126.
Colorado; Texas; Sonora.

U. stansburiana B. & G., 1852, Stansb. Rep., 345.
Utah; Nevada.

U. schottii Bd., 1858, Pr. Phil. Ac., 253.
California.

U. thalassina Cope, 1863, Pr. Phil. Ac., 104. (?).
Lower California.

U. nigricauda Cope, (?).
Lower California.

U. graciosa Hallow., 1854, Pr. Phil. Ac., 92.
California.

U. elegans Yarr.
La Paz, Cal.
Phymatolepis bicarinatus Dum., 1856, Arch. Mus., VIII, 549.
Puebla, Mexico.
Phymatolepis (Uta) irregularis Fisch., 1881, Abh. Nat. Ver. Brem., VII, 232.
Mexico.

SCELOPORUS Wiegm., 1828, Isis, 369.
Agama torquata Peale & Green, Jour. Phil. Ac., VI, 231.
Texas; Mexico.
Stellio undulatus (Bosc.) Latr., 1801, Rept., II, 40.
Pennsylvania to Florida and California.
(B) **S. occidentalis** B. & G., 1852, Pr. Phil. Ac., 175.
California; Washington Territory.
(C) **S. thayeri** B. & G., l. c., 127.
Texas to Sonora.
S. scalaris Wiegm., 1828, Isis, 369.
Mexico; Sonora.
S. couchii Bd., 1858, Pr. Phil. Ac., 254.
New Leon.
S. ornatus Bd., 1859, Mex. Bound., Rept., 5.
Sonora.
S. poinsetti B. & G., 1852, Pr. Phil. Ac., 126.
Texas; Sonora.
S. garmani Blgr., 1882, Pr. Z. S. Lond., 761, pl. 56.
Southern Dakota; Nebraska.
S. marmoratus Hallow., 1852, Pr. Phil. Ac., 178.
Southern California.
S. biseriatus Hallow., 1859, P. R. R. Rep., X, Williamson, 6.
Mexico.
S. consobrinus B. & G., 1854, Marcy's Exp., 208.
Utah; California.
(B) **S. gratiosus** B. & G., 1852, Pr. Phil. Ac., 69.
Utah.
S. Clarkii B & G., 1852, l. c., 127.
Arizona; Sonora.
(B) **S. zosteromus** Cope, 1863, Pr. Phil. Ac., 105.
Cape St. Lucas.
S. horridus Wiegm., 1834, Herp. Mex., 50.
Vera Cruz; Colima.
S. formosus Wiegm., l. c.
Colima.

S. microlepidotus Wiegm., l. c., 51.
Puebla; Colima.

S. floridanus Bd., 1858, Pr. Phil. Ac., 254.
Florida.

S. spinosus Wiegm., 1828, Isis, 369.
Mexico.

S. dugesi Boc., 1874, Miss. Sci. Mex., 188, p. 18, f. 7.
Colima.

S. jarrovi (Cope) Yarr., 1875, Wheeler's Rep., V, 569.
Arizona.

S. smaragdinus Yarr., l. c., 572.
Utah; Nevada.

S. tristichus Yarr., l. c.
Taos, New Mexico.

S. rufidorsum Yarr., 1882, Pr. Nat. Mus., 442.
La Paz, California.

S. utiformis Cope, 1864, Pr. Phil. Ac., 177.
Colima, Mexico.

S. gracilis B. & G., 1852, Pr. Phil. Ac., 75.
California.

PHRYNOSOMA Wiegm., 1828, Isis, 367.

Lacerta orbicularis Linn., 1758, Syst., I, 206.
Mexico.

Agama douglassi Bell, 1829, Trans. Linn. Soc., XVI, 105, pl. 10.
Dakota; Arizona.

(B) **Tapaya ornatissima** Grd., 1858, Wilkes Exp., Rept., 396.
Arizona; Mexico.

(C) **P. pygmaea** Yarr., 1882, Pr. U. S. Mus., 443.
Oregon.

Tapaya hernandesi Grd., 1858, Wilkes Exp., 395.
Mexico.

P. regale Grd., l. c., 406.
Arizona; New Mexico.

P. modestum Grd., 1852, Stansb. Rep., 365.
Texas; Arizona; New Mexico.

P. platyrhinum Grd., l. c., 361.
Utah; Arizona; Nevada.

Agama (Phrynos.) coronata Blainv., 1835, Nouv. Ann., 284, pl. 25, f. 1.
California.

P. blainvillei Gray, 1839, Rept. Beechey's Voy., 96, pl. 29, f. 1.
California; Arizona.

Agama cornuta Harl., 1825, Jour. Phil. Ac., IV, 299, pl. 20.
Texas; Mexico;
Anota mc'calli Hallow., 1852, Pr. Phil. Ac., 182.
Arizona; Nevada.
Tapaya boucardi Boc., 1874, Miss. Sci. Mex., 225, pl. xi, f. 4.
Mexico plateau.
P. braconnieri Boc., l. c., 233, pl. 7.
Oaxaca.
P. taurus Duges, 1869, Cat. Vert. Mex.
Mexico.
P. planiceps Hallow., 1852, Pr. Phil. Ac., 178.
Western Texas.
P. asio Cope, Pr. Phil. Ac., 178.
California; Mexico.

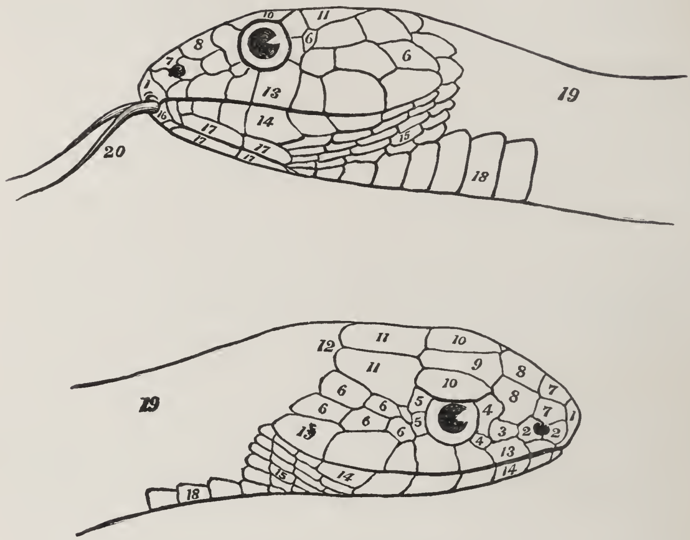
CYCLURA Harl., 1825, Jour. Phil. Ac., IV, 242.
Lacerta acanthura Shaw, 1802, Zool., III, 216.
Mexico; California.
C. teres Harl., l. c., 246.
Vera Cruz; California.
C. pectinata Wiegm., 1834, Herp. Mex., 42, pl. 2.
Colima.
Ctenosaura cycluroides Wiegm., 1828, Isis, 371.
C. (Ctenosaura) hemilopha Cope, 1863, Pr. Phil. Ac., 105.
Cape St. Lucas.

ANOLIS Daud., 1802, Rept., IV, 50.
Lacerta principalis Linn., 1754, Mus. Ad., — 1758, Syst., I, 201.
North Carolina to Texas.
A. sericeus Hallow., 1856, Pr. Phil. Ac., 227.
Jalapa, Mexico.
A. cooperi Bd., 1858, Pr. Phil. Ac., 254.
California.
A. tropidonotus Pet., 1863, Mb. Brl. Ak., 135.
Orizaba.
A. cymbos Cope, 1864, Pr. Phil. Ac., 173.
Vera Cruz.

AMPHISBAENIDAE.

CHIROTES Cuv., 1817, R. An., Ed. 1, 57.
Bipes canaliculatus Bonnat., 1789, Erpetol., 68.
California; Mexico.
LEPIDOSTERNON Wagler, 1824, Spix Serp. Brazil, 70.
L. floridanum Baird, 1858, Pr. Phil. Ac., 225.
Florida.

OPHIDIA.



COLUBER CONSTRICTOR.

1 Rostral.
2 Nasals.
3 Loreal.
4 Preoculars or Anteorbitals.
5 Postoculars or Postorbitals.
6 Temporals.
7 Internasals.
8 Prefrontals.
9 Frontal.
10 Supraciliaries or Supraoculars.
11 Parietals.
12 Occipitals.
13 Labials.
14 Infralabials.
15 Gulars.
16 Mental.
17 Submentals.
18 Ventrals.
19 Dorsals.
20 Tongue.

SCOLECOPHIDIA.

TYPHLOPIDAE.

TYPHLOPINAE.

TYPHLOPS Schneid., 1801, Amph., II, 339.
Ophthalmidion longissimum D. & B., 1844, Erp., VI, 263.
Texas; "North America."
T. perditus Pet., 1869, Mb. Brl. Ak., 435.
Orizaba.
T. basimaculatus Cope, 1866, Pr. Phil. Ac., 320.
Cordova; Orizaba.
T. emunctus Garman, 1883, Mem. Mus. Comp. Zool., Rept., 3.
Central America.

STENOSTOMINAE.

ANOMALEPIS Jan, 1861, Arch. Zool., 185.
A. mexicanus Jan, l. c.
Mexico.

STENOSTOMA Wagl., 1824, Spix Serp. Braz., 68.
Rena dulcis B. & G., 1853, Serp., 142.
Texas.
R. humilis B. & G., l. c., 143.
Valliecetas, California.
S. rubellum Grmn., 1883, Mem. M. C. Z., Rept., 130.
Uvalde, Texas.
S. tenuiculum Grmn., l. c., 5.
San Luis Potosi, Mexico.
S. myopicum Grmn., l. c., 6.
Tampico, Mexico.

SIAGONODON Pet., 1881, Gesellsch., 71.
S. dugesi Boc., 1882, Miss. Sci. Mex., Rept., 507, pl. 29, f. 9.
Colima.

ONYCHOPHIDIA.

ERYCIDAE.

CHARINA Gray, 1849, Cat. Snakes, 113.
Tortrix bottae Blainv., 1835, Nouv. Ann. Mus., 289, pl. 26, f. 1.
California to Mexico.

Wenona plumbea B. &. G., 1853, Serp., 154.
California to Puget Sound.
Lichanura trivirgata Cope, 1861, Pr. Phil. Ac., 304.
Lower California; Mexico.
(B) **L. myriolepis** Cope, 1868, Pr. Phil. Ac., 2.

BOIDAE.

BOA Linn., 1758, Syst., I, 214.
B. imperator Daud., 1802, Rept., V, 150.
Central America; Mexico.
B. mexicana Rapp.
Mexico.

CHILABOTHRUS D. & B., 1844, Erp., VI, 562.
Boa inornata Reinh., 1843, Dansk. Vid. Selsk., pl. 21–23.
West Indies; Central America; Mexico.

ACACOPHIDIA.

COLUBROIDEA.

DIPSADIDAE.

LEPTOGNATHUS Dum., 1852, Mem. Acad., XXIII, 467.
Tropidodipsas fasciata Gthr., 1858, Cat. 181.
Mexico.
L. dumerili Jan, 1863, Sist., 101.
Mexico.
Coluber nebulatus Linn., 1754, Mus. Ad., 32, pl. 24, f. 1.
Brazil to Mexico; West Indies (Gthr.).
L. dimidiatus Gthr., 1872, Ann. Mag., 31.
Mexico.
L. brevis Dum., 1852, Mem. Acad., 23, p. 467.
Mexico.

SIBON Fitz., 1826, Neue Class., 60.
Dipsas biscutata D. & B., 1854, Erp., VII, 1153.
Central America to Mexico.
(B) **Dipsas biscutata** var. **latifascia** Pet., 1869, Mb. Brl. Ak., 877.
Pueblo, Mexico.
Coluber annulatus Linn., 1754, Mus. Ad. Fridr., pl. 8, f. 2.
Mexico to Brazil.
(B) **Dipsas septentrionalis** Kenn., 1859, Mex. Bound., II, 16, pl. viii, f. 1.
Texas; Arizona; Mexico.

Leptodeira torquata Gthr., 1860, Ann. Mag.
Nicaragua.
(B) **L. pacifica** Cope, 1868, Pr. Phil. Ac., 310.
Mazatlan, Mexico.
(C) **L. personata** Cope, l. c.
Mazatlan.
L. discolor Gthr., 1860, Pr. Zool. Soc., 317.
Oaxaca.

DENDROPHIDAE.

LEPTOPHIS Bell, 1825, Zool. Jour., 329.
L. mexicanus D. & B., 1854, Erp., VII, 536.
Mexico.

NATRICIDAE.

TROPIDONOTUS Kuhl, 1826, Isis, 205.
(CHILOPOMA.)
C. rufipunctatum Yarr., 1875, Wheeler's Exp., V, 543, pl. xx, f. 1.
Southern Arizona.
(EUTAENIA.)
Coluber saurita Linn., 1766, Syst., I, 385.
Mississippi valley to Atlantic.
(B) **Eutaenia faireyi** B. & G., 1853, Serp., 25.
Minnesota and Wisconsin southward.
(C) **E. Sackenii** Kenn., 1859, Pr. Phil. Ac., 98.
Florida.
(D) **Coluber proximus** Say, 1823, Long's Exp., I, 187.
Arkansas and Texas to Mexico.
(E) **E. radix** B. & G., 1853, Serp., 34.
Wisconsin; Illinois.
Coluber sirtalis Linn., 1758, Syst., I, 222.
Nova Scotia to Mississippi valley.
(B) **C. ordinatus** Linn., 1766, Syst., I, 379.
Coast from Nova Scotia to Georgia and Alabama.
(C) **E. marciana** B. & G., 1853, Serp., 36.
Kansas to Texas and Mexico.
(D) **Coluber parietalis** Say, 1823, Long's Exp., I, 186.
Missouri basin to Utah.
(E) **E. vagrans** B. & G., 1853, Serp., 35.
Rocky mountains to Sierras; Sonora.
(F) **Trop. collaris** Jan, 1863, Sist., 69.
Southern Mexico; Panama.

(G) **E. leptocephala** B. & G., 1853, Serp., 29.
Oregon.

(H) **Coluber infernalis** Blainv., 1835, Nouv. Ann. Mus., 291, pl. 26, f. 3.
California to Mexico.

(I) **E. atrata** Kenn., 1860, P. R. R. Rep., XII, 296.
California.

(J) **Trop. quadriserialis** Fisch., 1879, Verh. Nat. Ver. Hamb., 82.
Mazatlan.

Atomarchus multimaculatus Cope, 1883, Am. Nat., 1300.
New Mexico.

(NERODIA.)

Coluber sipedon Linn., 1758, Syst., I, 219.
Mississippi valley to Maine.

(B) **C. fasciatus** Linn., 1766, Syst., I, 378.
Southern States.

(C) **C. erythrogaster** Holbr., 1838, Herp., II, 91, pl. 19.
Southeastern States.

(D) **Trop. rhombifer** B. & G., 1852, Pr. Phil. Ac., 177.
Mississippi valley to Wisconsin.

Trop. taxispilotus Holbr., 1842, Herp., IV, 35, pl. 8.
Southeastern States.

T. cyclopion D. & B., 1854, Erp., VII, 576.
Ohio to Florida.

Nerodia compressicauda Kenn., 1860, Pr. Phil. Ac., 335.
Florida.

(REGINA.)

Coluber leberis Linn., 1758, Syst., I, 216.
Michigan to Texas.

(B) **C. rigidus** Say, 1825, Jour. Phil. Ac., 239.
New York, southward and westward.

(C) **Regina clarkii** B. & G., 1853, Serp., 48.
Texas to Mexico.

(D) **R. grahamii** B. & G., l. c., 47.
Michigan to Texas.

(E) **R. valida** Kenn., 1860, Pr. Phil. Ac., 334.
California to Mexico.

R. kirtlandi Kenn., 1856, Pr. Phil. Ac., 95.
Illinois to Ohio.

STORERIA B. & G., 1853, Serp., 135.

Tropidoclonium storerioides Cope, 1865, Pr. Phil. Ac., 190.
Mexico.

Tropidonotus occipitomaculatus Storer, 1839, Rept. Mass. 230.

Mississippi valley and eastward.

Trop. dekayi Holbr., 1842, Herp., IV, 53, pl. 14.

Maine to Mexico.

Adelophis copei Cope, 1879, Pr. Am. Phil. Soc., 265.

Guadalaxara.

Microps lineatus Hallow., 1856, Pr. Phil. Ac., 241.

Texas to Kansas.

HELICOPS Wagler, 1830, Amph., 170.

H. alleni Grmn., 1874, Pr. B. N. H. Soc., 92.

Florida.

HYDROPS Wagl., 1830, Amph., 170.

Coluber erythrogrammus Latr., 1802, Rept., IV, 141.

Illinois and Virginia southward.

C. abacurus Holbr., 1836, Herp., I, 119, pl. 23.

North Carolina to Texas.

Homalopsis quinquevittatus D. & B., 1854, Erp., VII, 975.

Mexico; Central America.

Calopisma septemvittatum Fisch., 1879, Verh. Nat. Ver. Hamb., 84.

Mexico.

COLUBRIDAE.

SALVADORA B. & G., 1853, Serp., 104. (Not preoccupied among animals.)

S. grahamii B. & G., l. c.

California to Mexico; Utah to Texas.

(B) **S. bairdii** Jan, 1861, Icon., livr. 1, pl. 3, f. 2.

Mexico.

(C) **Phymothyra hexalepis** Cope, 1866, Pr. Phil. Ac., 305.

Arizona.

Phym. decurtata Cope, 1868, Pr. Phil. Ac., 310.

Lower California.

CYCLOPHIS Gthr., 1858, Cat. Serp., 119.

Coluber vernalis (De K.) Harl., 1827, Jour. Phil. Ac., 361.

Nova Scotia to Rocky Mountains.

PHYLLOPHILOPHIS Grmn., 1883, Mem. M. C. Z., Rept., 40, 146.

Maryland to Mexico.

Coluber aestivus Linn., 1766, Syst., I, 387.

COLUBER Linn., 1748, Syst., p. 34. —1758, Syst., I, 216, —1766, Syst., I, 375 (Part.).

(BASCANIUM.)

Coluber constrictor Linn., 1758, Syst., I, 216, —1766, Syst., 1, 385.

Nova Scotia to Texas.

(B) **C. flaviventris** Say, 1823, Long's Exp., I, 185.

Mississippi valley west to Pacific.

Coryphodon mentovarius D. & B., 1854, Erp., VII, 187.

Mexico.

(MASTICOPHIS.)

Coluber flagellum Shaw, 1802, Zool., III, 475.

(B) **C. testaceus** Say, 1823, Long's Exp., 248.

Dakota to Texas and the Pacific.

(C) **Drymobius aurigulus** Cope, 1861, Pr. Phil. Ac., 301.

Lower California.

Zamenis mexicanus D. &. B., 1854, Erp., VII, 695.

Mexico.

Masticophis spinalis Pet., 1866, Mb. Brl. Ak., 91.

Mexico.

Leptophis taeniata Hallow., 1852, Pr. Phil. Ac., 181.

Plains to the Pacific.

(B) **Masticophis bilineatus** Jan, Sist., 40.

Mexico.

SPILOTES Wagler, 1830, Amph., 179.

(GEORGIA.)

Coluber couperi Holbr., 1842, Herp., III, 75, pl. 16.

Gulf States.

C. obsoletus Holbr., l. c., 61, pl. 12.

Florida to Texas.

(SPILOTES.)

Coluber corais (Cuv.) Boie., 1827, Isis, 537.

Brazil to Mexico.

C. variabilis Max., 1825, Beitr., 271.

Mexico to Brazil.

(B) **Spilot. pullatus** var. **auribundus** Cope, 1861, Pr. Phil. Ac., 300.

Mexico.

S. melanurus D. & B., 1854, Erp., VII, 224.

Mexico.

S. poecilonotus Gthr., 1858, Cat. Serp., 100.

Mexico.

PITYOPHIS Holbr., 1842, Herp., IV, 7.

Coluber melanoleucus Daud., 1803, Rept., VI, 409.
East of the Mississippi, Ohio and Pennsylvania southward.

C. catenifer Blainv., 1835, Nouv. Ann. Mus., IV, 290, pl. 26, f. 2.
Oregon to Mexico.

(B) **C. sayi** Schleg., 1837, Ess., II, 157.
Rocky Mountains to Illinois.

(C) **P. mexicanus** D. & B., 1854, Erp., VII, 236.
Mexico.

(D) **Elaphis deppei** D. & B., 1854, Erp., VII, 268.
Arizona to Mexico.

(E) **Churchillia bellona** B. & G., 1852, Stansb. Exp., 350.
Utah basin.

(F) **C. vertebralis** Blainv., 1835, l. c., 293, pl. 27, f. 2.
Lower California.

ELAPHIS Aldrov., 1640, Serp. Drac., 267, —1765, reprint; Bonap., 1831, Saggio.

(SCOTOPHIS.)

Coluber obsoletus Say, 1823, Long's Exp., I, 140.
Mississippi valley.

• (B) **C. alleghaniensis** Holbr., 1842, III, 219.
New England to Alabama.

(C) **S. lindheimeri** B. & G., 1853, Serp., 74.
Illinois to Texas.

(D) **C. bairdi** Yarr., 1880, Bull. U. S. Mus., 41.
Fort Davis, Texas.

(E) **S. confinis** B. & G., 1853, Serp., 76.

C. guttatus Linn., 1766, Syst., I, 385.
Virginia to Louisiana.

(B) **S. vulpinus** B. & G., 1853, Serp., 75.
Massachusetts to Nebraska.

C. quadrivittatus Holbr., l. c., 80, pl. 20.

DROMICUS Bibr., 1843, Rept. Cuba, Sagra, 221.

D. laureatus Gthr., 1868, Ann. Mag., 419.
City of Mexico.

D. flavilatus Cope, 1871, Pr. Phil. Ac.
Florida to North Carolina.

Herpetodryas margaritiferus Schleg., 1837, Ess., I, 151, II, 184.
Mexico; Central America.

D. putnamii Jan, 1863, Sist., 67.
Southern Mexico.

CORONELLIDAE.

TACHYMENIS Wiegm., 1834, Act. Acad. Caes. Leop., 252.

Tomodon lineatum D. & B., 1854, Erp., VII, 936.
Mexico.

Taeniophis imperialis B. & G., 1855, Gilliss' Exp., II, 215.
Texas and Mexico.

Coniophanes lateritia Cope, 1861, Pr. Phil. Ac., 524.
Guadalaxara.

Coniophanes proterops Cope, 1860, Pr. Phil. Ac., 249.
Mexico; New Granada.

Coronella fissidens Gthr., 1858, Cat. Serp., 36.
Mexico.

Coronella bipunctata Gthr., l. c.
Mexico.

T. melanocephala Pet., 1869, Mb. Brl. Ak., 876.
Mexico.

ERYTHROLAMPRUS Boie, 1826, Isis, 981.

E. guentheri Grmn., 1883, Mem. M. C. Z., Rept., 63.
=**E. venustissimus** var. **D** Gthr., 1858, Cat., 48.
" Mexico."

OPHIBOLUS B. & G., 1853, Serp., 82.

Coluber doliatus Linn., 1766, Syst., 1, 379.
Southeastern States.

Osceola elapsoidea B. & G., 1853, Serp., 133.
Southern States east of Mississippi river.

C. triangulus Boie, 1827, Isis, 537.
Mississippi valley eastward to Canada.

(**B**) **C. calligaster** Harl., 1835, Med. Res., 122.
Northern Mississippi valley.

(**C**) **O. triang.** var. **mexicanus** Grmn., 1883, Mem. M. C. Z., Rept., 66.
San Luis Potosi.

(**D**) **O. doliatus** B. & G., 1853, Serp., 89.
Nebraska and southward.

(**E**) **O. gentilis** B. & G., l. c., 90.
Arkansas to Utah.

(**F**) **C. (Zacholus) zonatus** Blainv., 1835, Ann. Mus., IV, 293.
California.

(**G**) **Lampropeltis annulata** Kenn., 1860, Pr. Phil. Ac., 329.
Mexico.

(H) **Coronella rhombomaculata** Holbr., 1842, Herp., III, 103, pl. 23.
Southeastern U. S.

Coluber getulus Linn., 1766, Syst., I, 382.
Southern States to Texas.

(B) **Coronella sayi** Holbr., 1842, Herp., III, 99, pl. 22.
Mississippi valley, Illinois to Texas.

(C) **O. boylii** B. & G., 1853, l. c., 82.
California to Mexico.

(D) **O. splendidus** B. & G., l. c., 83.
Arizona and southern California to Mexico.

(E) **O. pyrrhomelanus** Cope, 1866, Pr. Phil. Ac., 305.
Arizona; Sonora.

LIOPHIS Wagl., 1830, Amph., 187.

Pliocercus elapoides Cope, 1860, Pr. Phil. Ac., 253.
Mexico.

DIADOPHIS B. & G., 1853, Serp., 112.

Enicognathus annulatus D. & B., 1854, Erp., VII, 335, pl. 80, f. 1–3.
Mexico.

Coronella decorata Gthr., 1858, Cat. Serp., 35.
Southern Mexico.

Rhadinea fulvivitta Cope, 1875, Jour. Phil. Ac., 139.
Southern Mexico.

Coluber punctatus Linn., 1766, Syst., I, 376.
Southern and Eastern States to Nova Scotia.

(B) **D. arnyi** Kenn., 1859, Pr. Phil. Ac., 99.
Illinois to Arkansas.

(C) **D. docilis** B. & G., 1853, Serp., 114.
Texas to Mexico.

(D) **D. amabilis** B. & G., l. c., 113.
Arizona to California.

D. regalis B. & G., l. c., 115.
Mexico.

RHINOCHEILUS B. & G., 1853, Serp., 120.

R. lecontei B. & G., l. c., 120, 161.
Texas to California.

(B) **R. lecontei** var. **tesselatus** Grmn., 1883, Mem. M. C. Z., Rept., 74.
Mexico.

HETERODON (Pal. de Beauv., 1799) Latr., 1802, Rept., IV, 32.

H. platyrhinus Latr., l. c., 32, pl. 28, f. 1–3.
Eastern, Middle and Southern States.

(B) **H. niger** Troost, 1836, Ann. N. Y. Lyc., 186.
Southern States east of Mississippi river.

Coluber simus Linn., 1766, Syst., I, 375.
Mississippi valley to the Atlantic.

(B) **H. nasicus** B & G., 1852, Stansb. Exp., 352.
California to Texas and Nebraska.

(C) **H. kennerlyi** Kenn., 1860, Pr. Phil. Ac., 336.
Sonora.

CEMOPHORA Cope, 1860, Pr. Phil. Ac., 244.

Coluber coccinneus Blumenb., 1788, Licht. & Voigt. Mag., pl. V.
Southern States east of Texas.

(B) **C. copei** Jan, 1863, Sist., 45.
Tennessee.

XENODON Boie, 1827, Isis, 541.

X. bertholdi Jan, 1863, Arch. Zool., II, 108.
Mexico.

HYPSIGLENA Cope, 1860, Pr. Phil. Ac., 246.

H. ochrorhynchus Cope, l. c.
Lower California.

(B) **H. chlorophaea** Cope, l. c.
Arizona to Sonora.

CALAMARIDAE.

FICIMIA Gray, 1849, Cat. Serp., 80.

Toluca frontalis Cope, 1864, Pr. Phil. Ac., 167.
Colima.

Gyalopion canum Cope, 1860, Pr. Phil. Ac., 243, 310.
Arizona.

Conopsis nasus Gthr., 1858, Cat., 6.
California.

Toluca lineata (Kenn.) Bd., 1859, Mex. Bound., II, Rept., 23, pl. 21, f. 2.
Mexico.

Oxyrhina maculata Jan, 1862, Arch. Zool., II, 54, 61.
Mexico.

Amblymetopon variegatum Gthr., 1858, Cat. Serp., 7.
Mexico.

F. olivacea Gray, 1849, Cat. Serp., 80.
Mexico.

CHEILORHINA Jan., 1862, Arch. Zool., II, 57.
C. villarsii Jan., l. c.
Western Mexico.

STENORHINA D. & B., 1854, Erp., VII, 865.
S. freminvillei D. & B., l. c., 868.
Central America and Mexico.
Microphis quinquelineatus Hallow., 1854, Pr. Phil. Ac., 97.
Mexico.

TANTILLA B. &. G., 1853, Serp., 131.
T. gracilis B. & G., l. c., 132, 161.
Texas.
(B) **T. hallowelli** Cope, 1860, Pr. Phil. Ac., 77.
Kansas.
(C) **T. calamarina** Cope, 1866, Pr. Phil. Ac., 320.
Guadalaxara.
T. nigriceps Kenn., 1860, Pr. Phil. Ac., 328.
Texas; New Mexico.
T. coronata B. & G., 1853, Serp., 131.
Gulf States.
(B) **Homalocranion wagneri** Jan, 1862, Arch. Zool., II, 50.
Florida.
Coluber planiceps Blainv., 1835, Ann. Mus., IX, 294, pl. 27, f. 3.
California.

ELAPOMORPHUS (Wiegm.) Fitz., 1843, Syst., 25.
E. mexicanus Gthr., 1862, Ann. Mag., pl. 9, f. 1 (Extr., p. 6).
Mexico.

CONTIA B. & G., 1853, Serp., 110.

(SONORA.)
S. semiannulata B. & G., 1853, Serp., 110.
Sonora.
Rhinostoma occipitale Hallow., 1854, Pr. Phil. Ac., 95.
Arizona.
(B) **Lamprosoma annulatum** Bd., 1859, Mex. Bound., II, 22.
Arizona.
C. isozona Cope, 1866, Pr. Phil. Ac., 304.
Arizona to Utah.

(PROCINURA.)
P. aemula Cope, 1871, Pr. Phil. Ac., 223. (?Position).
Mexican plateau.

(**CONTIA.**)

C. mitis B. & G., 1853, Serp., 110.
California.

Lamprosoma episcopum Kenn., 1859, Mex. Bound., II, Rept., 22, pl. 8, f. 1.
Texas.

LODIA B & G., 1853, Serp., 116.

Calamaria tenuis B. & G., 1852, Pr. Phil. Ac., 176.
Oregon and Washington Territory.

NINIA B. & G., Serp., 49.

Chersodromus liebmanni Reinh., 1860, Vid. Medd. Kjobenh., 35, pl. IV, f. 10, 11.
Vera Cruz; Mexico.

Streptophorus sebae D. & B., 1854, Erp., VII, 515.
Mexico.

S. sebae var. **collaris** Jan, 1865, Icon., livr. 12, pl. 3, f. 6.
Mexico.

Elapoides sieboldi Jan, 1862, Arch. Zool., II, 21.
Mexico.

N. dimidiata B. & G., 1853, Serp., 49.
Mexico.

VIRGINIA B. & G., 1853, Serp., 127.

Coluber striatulus Linn., 1766, Syst., I, 375.
Virginia to Texas.

V. inornata Grmn., 1883, Mem. M. C. Z., Rept., 97.
Texas.

V. elegans Kenn., 1859, Pr. Phil. Ac., 99.
Southern Illinois.

V. valeriae B. & G., l. c., 127.
Maryland to Georgia and Illinois.

(B) **Carphophis harperti** D. & B., 1854, Erp., VII, 135.
Georgia to Texas.

CARPHOPHIS Gerv., 1843, D'Orb. Dict. N. Hist., III, 191.

Chilomeniscus stramineus Cope, 1861, Pr. Phil. Ac., 33.
Lower California.

Chilom. cinctus Cope, l. c., 303.
Guaymas.

Celuta helenae Kenn., 1859, Pr. Phil. Ac., 100.
Illinois to Mississippi.

Carphophis amoena Gerv., 1843, l. c., 191.
Massachusetts to Illinois and southward.

(B) **Celuta vermis** Kenn., 1859, Pr. Phil. Ac., 99.
Missouri and southward.

GEOPHIS Wagler, 1830, Amph., 342.
Rabdosoma semidoliatum D. & B., 1854, Erp., VII, 93.
Mexico.
G. bicolor Gthr., 1868, Ann. Mag., 413.
Valley of Mexico.
G. latifrontalis Grmn., 1883, Mem. M. C. Z., Rept., 103.
San Luis Potosi.
G. unicolor Fisch., 1881, Abh. Nat. Ver. Brem., VII, 227, pl. xv, f. 1–3.
Mexico.
Sympholis lippiens Cope, Pr. Phil. Ac., 524.
Guadalaxara.

TOXICOPHIDIA.

PROTEROGLYPHA.

CONOCERCA.

ELAPIDAE.

ELAPS Schneid., 1801, Amph., 289.
Coluber fulvius Linn., 1766, Syst., I, 381.
Southern States east of the Mississippi.
(B) **E. nigrocinctus** Grd., 1854, Pr. Phil. Ac., 226.
Central America to Mexico.
(C) **E. affinis** Jan, 1859, Rev. and Mag. Zool., 6, 14, pl. B, f. 2.
Mexico.
(D) **E. bipunctiger** D. & B., 1854, Erp., VII, 1227.
Mexico; Florida.
(E) **E. tenere** B. & G., 1853, Serp., 22, 156.
Texas.
(F) **E. apiatus** Jan, 1859, l. c., pp. 6, 11, pl. A, f. 4.
Vera Cruz.
(G) **E. epistema** D. & B., 1854, Erp., VII, 1222.
Mexico.
(H) **E. diastema** D. & B., l. c., 1222.
Mexico.
(I) **E. cerebripunctatus** Pet., 1869, Mb. Brl. Ak., 877.
Pueblo.
E. euryxanthus Kenn., 1860, Pr. Phil. Ac., 337.
Arizona to Mexico.
E. marcgravii var. **laticollaris** Pet., 1869, Mb. Brl. Ak.
Pueblo.

E. decoratus Jan, 1859, l. c., pp. 7, 14, pl. B, f. 5.
Mexico.
E. elegans Jan, l. c., pp. 6, 13, pl. B, f. 1.
Mexico.

PLATYCERCA.

HYDROPHIDAE.

PELAMIS Daud., 1803, Rept., VII, 357.
Anguis platura Linn., 1766, Syst., I, 391.
West coast of Mexico and Central America to East Indies and China.

SOLENOGLYPHA.

BOTHROPHERA.

CROTALIDAE.

CROTALUS Linn., 1754, Mus. Ad. Fridr., 39.
C. durissus Linn., 1758, Syst., I, 214.
Brazil to Mexico.
(B) **C. molossus** B. & G., 1853, Serp., 10.
North Mexico; Arizona; New Mexico.
(C) **Caudisona basilisca** Cope, 1864, Pr. Phil. Ac., 166.
Western Mexico.
C. adamanteus Beauv., 1799, Trans. Ann. Phil. Soc., IV, 368.
Texas to North Carolina.
(B) **Caudisona scutulatus** Kenn., 1861, Pr. Phil. Ac., 207.
Arizona; Mexico.
(C) **Crotalus atrox** B. & G., l. c., 5, 156.
Texas to Mexico.
C. confluentus Say, 1823, Long's Exp., II, 48.
Dakota to Texas.
(B) **Caudisona pyrrha** Cope, 1866, Pr. Phil. Ac., 308, 310.
Arizona.
C. oregonus Holbr., 1842, III, 21, pl. 3.
Oregon to California.
(B) **C. lucifer** B. & G., 1852, Pr. Phil. Ac., 177.
California to Mexico.
(C) **C. lucifer** var. **cerberus** Coues, 1875, Wheeler's Rep., V, 607.
Arizona.

(D) **Caudisona mitchellii** Cope, 1861, Pr. Phil. Ac., 293.
Lower California.

(E) **Caud. enyo** Cope, l. c., 293.
Lower California.

Crotalus exsul Grmn., 1883, Mem. M. C. Z., Rept., 114.
Cedros Island.

C. horridus Linn., 1758, Syst., I, 214.
New England to Texas.

C. cerastes Hallow., 1854, Pr. Phil. Ac., 95.
California; Arizona; Mexico.

?**Caudisona lepida** Kenn., 1861, Pr. Phil. Ac., 206.
Mexico.

Crotalus tigris (Kenn.) Bd., 1859, Mex. Bound., II, Rept., 14, pl. 4.
Mexico.

C. triseriatus Wiegm., 1828, Mus. Berl.
Mexico.

(B) **C. jimenezii** Duges, 1879, La Naturaleza, IV, 23.
Mexico.

SISTRURUS Grmn., 1883, Mem. M. C. Z., Rept., 110, 118, 176.

Crotalinus catenatus Raf., 1818, Am. Month. Mag., IV, 41.
Ohio and Michigan to the Plains and south to Mississippi.

(B) **Crotalophorus consors** B. & G., 1853, Serp., 12.
Texas.

Crotalus miliarius Linn., 1766, Syst., I, 372.
Southern States.

(B) **Crotaloph. edwardsii** B. & G., l. c., 15.
Texas; Arizona; Sonora; Mexico.

(C) **Crotalus ravus** Cope, 1865, Pr. Phil. Ac., 191.
Mexican plateau.

Crotalus intermedius Fisch., 1881, Abh. Nat. Ver. Brem., VII, 230, pl. XIV, f. 1–4.
Mexico.

ANCISTRODON Pal. de Beauv., 1799, Trans. Am. Phil. Soc., IV, 381.

Coluber contortrix Linn., 1758, Syst., I, 216.
Mississippi valley to New England.

(B) **Acontias atrofuscus** Troost., 1836, Ann. N. Y. Lyc., 181. Mountains from Virginia southward.

Crotalus piscivorus LaC., 1789, Quad. Ovip. Serp., II, pp. 130, 424.
South Carolina to Texas.

(B) **Toxicophis pugnax** B. & G., 1853, Serp., 20, 156.
Texas.

A. bilineatus Gthr., 1863, Ann. Mag., 364.
West Mexico; Tehuantepec.

BATRACHIA.

APODA.

CAECILIIDAE.

DERMOPHIS Pet., 1879, Mb. Brl. Akad., 937.
Siphonops mexicanus D. & B., 1841, Erp., VIII, 284.
Mexico.

CAUDATA.

SIRENIDAE.

SIREN Linn., 1766, Act. Acad. Upsal. (dissert. auct. Osterdam), 15.
S. lacertina Linn., 1766, l. c.
North Carolina to Illinois and Mexico.

PSEUDOBRANCHUS Gray, 1825, Ann. Phil., 216.
Siren striata LeC., 1824, Ann. Lyc. N. Y., I, 54, pl. 4.
South Carolina; Georgia; Simahmoo Bay, Washington Territory (Yarrow).

PROTEIDAE.

NECTURUS Raf., 1819, Jour. Phys., Vol. 88, 417.
N. maculatus Raf., l. c.
Mississippi valley and eastward; Canada.
Menobranchus punctatus Gibbes, 1853, Jour. B. N. H. Soc., 369.
North Carolina; South Carolina.

AMPHIUMIDAE.

AMPHIUMA Linn., Garden, 1821, Linn. Corresp., Smith, 333.
A. means Linn., 1821, l. c., 333, 532, 599.
North Carolina to Louisiana.
A. tridactyla Cuv., 1828, Mem. Mus., XIV, pl. 1.

CRYPTOBRANCHUS Leuck., 1821, Isis, 257.

Salamandra alleghaniensis Latr., 1802, Rept., II, 253 (index).
New York to Missouri.

Menopoma fusca Holbr., 1842, Herp., V, 99, pl. 33.
Pennsylvania to Louisiana.

SALAMANDROIDEA.

AMBLYSTOMATIDAE.

AMBLYSTOMA Tschudi, 1838, Batr., 57.

Salamandra opaca Gravenh., 1807, Ueb. Zool. Syst., 431.
New Hampshire to Mexico.

S. talpoidea Holbr., 1842, Herp., V, 73, pl. 24.
South Carolina to Louisiana.

S. tigrina Green, 1825, Jour. Phil. Ac., V, 116.
Mississippi valley to New Jersey.

(B) **A. bicolor** Hallow., 1857, Pr. Phil. Ac., 215.
New Jersey.

(C) **A. mavortium** Bd., 1849, Jour. Phil. Ac., I, 292.
Dakota to Mexico.

(D) **A. californiense** Gray, 1853, Pr. Z. S. Lond., 11, pl. 7.
California.

(E) **A. trisruptum** Cope, 1867, Pr. Phil. Ac., 194.
Colorado to New Mexico.

(F) **A. xiphias** Cope, 1867, l. c., 192.
Ohio.

(G) **A. obscurum** (Bd.) Cope, l. c., 192.
Iowa.

Lacerta punctata Linn., 1766, Syst., 370.
Maine to Texas.

A. macrodactylum Bd., 1849, Jour. Phil. Ac., 292.
Oregon.

A. paroticum (Bd.) Cope, 1867, Pr. Phil. Ac., 200.
Oregon; Puget sound.

A. aterrimum Cope, 1867, Pr. Phil. Ac., 201 (s. d.).
Rocky mountains.

A. tenebrosum B. & G., 1852, Pr. Phil. Ac., 174.
Oregon.

A. conspersum Cope, 1859, Pr. Phil. Ac., 123.
Carlisle, Pennsylvania.

Salamandra texana Matthes, 1855, Alg. Deutsch. Nat. Zeit., 266.(?)

S. jeffersonania Green, 1827, Cont. Macl. Lyc., 4.
New England and Canada to Illinois.

(B) **A. laterale** Hallow., 1858, Jour. Phil. Ac., III, 352.
Canada to Wisconsin.

(C) **A. platineum** Cope, 1867, Pr. Phil. Ac., 198.
Ohio.

(D) **A. fuscum** Hallow., 1858, l. c., 355.
Indiana; Virginia.

A. cingulatum Cope, 1867, Pr. Phil. Ac., 205 (s. d.).
South Carolina.

A. microstomum Cope, 1867, l. c., 206.
Louisiana to Ohio.

Gyrinus mexicanus Shaw, 1800, Nat. Misc., 343.
Mexico.

Axolotes maculata Owen, 1844, Ann. Mag., XIV, 23. (?)
Mexico.

DICAMPTODON Strauch, 1870, Mem. Acad. Imp. St. Petersb. (4), XVI, 68.

Triton ensatus Eschsch., 1833, Zool. Atlas, pt. 5, p. 6, pl. 22.
California.

PLETHODONTIDAE.

ANAIDES Bd., 1849, Icon. Encycl., II, 256.

Salamandra lugubris Hallow., 1848, Jour. Phil. Ac. (2), I, 126.
California.

A. ferreus Cope, 1869, Pr. Phil. Ac., 109.
Oregon.

PLETHODON Tschudi, 1838, Batr., 92.

Heredia oregonensis Grd., 1856, Pr. Phil. Ac., 235.
Oregon; California.

P. flavipunctatus Strauch, 1870, Salamand., 71.
California.

Salamandra glutinosa Green, 1818, Jour. Phil. Ac., I, 357.
Louisiana to Wisconsin and east.

P. croceater Cope, 1867, Pr. Phil. Ac., 210.
Fort Tejon, California.

P. intermedius (Bd.) Cope, l. c., 209.
Vancouver's island.

S. erythronota Green., 1818, Jour. Phil. Ac., 356.
Wisconsin to Canada.

(B) **S. cinerea** Green, l. c., 356.
Indiana; Pennsylvania; Canada.

(C) **P. dorsalis** Baird.
Kentucky.

P. iecanus (Cope) Yarrow, 1883, (?).

HEMIDACTYLIUM Tschudi, 1838, Batr., 59, 94.

Salamandra scutata Schleg., 1838, Fauna Japon., Amph., 119.
Canada to Texas.

Salamandrina attenuata Eschsch., 1833, Zool. Atl., pt. V, 1, pl. 21.
California.

H. pacificum Cope, 1865, Pr. Phil. Ac., 195.
California.

Batrachoseps nigriventris Cope, 1869, Pr. Phil. Ac., 98.
California.

GEOTRITON Bonap., 1831, Saggio, 84 (Spelerpes Raf., 1832).

Salamandra rubra Latr., 1802, Rept., IV, 305.
Missouri to Florida.

(B) **Pseudotriton montanus** Bd., 1849, Jour. Phil. Ac. (2), I, 293.
New York to South Carolina.

(C) **Spelerpes sticticeps** Baird.
Mexico.

Salam. longicauda Green, 1818, Jour. Phil. Ac., I, 351.
Ohio to Georgia.

Sal. guttolineata Holbr., 1842, Herp., V, 29, pl. 7.
Ohio to Georgia.

Sal. bilineata Green, 1818, Jour. Phil. Ac., I, 352.
Florida to Ohio.

Sal. variegata Gray, 1831, Synops., 107.
City of Mexico to Central America.

Spelerp. multiplicatus Cope, 1869, Pr. Phil. Ac., 106.
Arkansas.

S. lineolus Cope, 1865, Pr. Phil. Ac., 197. (?)
Vera Cruz; Orizaba.

S. chiropterus Cope, 1863, Pr. Phil. Ac., 54. (?)
Mexico.

S. cephalicus Cope, 1865, Pr. Phil. Ac., 196.
Mexico.

S. leprosus Cope, Pr. Phil. Ac., 105.
Vera Cruz; Oaxaca; Orizaba.

S. belli Gray, 1859, Batr. Grad., 46.
Mexico.

Oedipus rufescens Cope, 1869, Pr. Phil. Ac., 104.
Vera Cruz.

O. morio Cope, l. c., 103.
Mexico.

Pseudotriton marginatus Hallow., 1856, Pr. Phil. Ac., 130.
Georgia.

Salam. porphyritica Green, 1827, Macl. Lyc., I, 3, pl. 1, f. 2.
Ohio to Massachusetts and Georgia.

Spelerp. laticeps Broc., 1883, Miss. Sci. Mex., Batr., 110, pl. 18, f. 1.
Vera Cruz.

Bolitoglossa mexicana D. & B., 1854, Erp., IX, 93, pl. 104, f. 1.
Mexico.

MANCULUS Cope, 1869, Pr. Phil. Ac., 101.

Salamandra quadrigitata Holbr., 1842, Herp., V, 65, pl. 21.
North Carolina to Florida.

M. remifer Cope, 1869, Rep. Peab. Ac., 84.
Florida.

DESMOGNATHIDAE.

DESMOGNATHUS Bd., 1849, Jour. Phil. Ac. (2), I, 282.

Triturus fuscus Raf., 1820, Ann. of Nat. (Bd.).
New York to Louisiana.

(B) **S. auriculata** Holbr., l. c., 47, pl. 12.
Ohio to Georgia.

Salam. nigra Green, 1818, Jour. Phil. Ac., I, 352.
Illinois to Georgia.

S. quadrimaculata Holbr., 1842, Herp., V, 49, pl. 13.
Florida to New York.

D. ochrophaea Cope, 1859, Pr. Phil. Ac., 124.
New York to Georgia.

THORIUS Cope, 1869, Am. Nat., 222.

T. pennatulus Cope, l. c.
Mexico.

SALAMANDRIDAE.

DIEMYCTYLUS Raf., 1820, Ann. Nat., No. 22.

Triturus (Notophthalmus) miniatus Raf., l. c.
Canada to Texas.

(B) **T. (Diemyctylus) viridescens** Raf., l. c.
Canada to Texas.

Triton torosus Eschsch., 1833, Zool. Atlas, V, 12, pl. 21, f. 15.
Oregon; California.

ECAUDATA.

RANIDAE.

RANA Linn., 1735, Syst., —1758, Syst., I, 210, —1766, Syst., I, 354.

R. catesbeiana Shaw, 1802, Zool., III, 106.
Mississippi valley to the Atlantic.

(B) **R. horiconensis** Holbr., 1842, Herp., IV, 83, pl. 19.
New York; Canada.

R. clamitans Latr., 1801, Rept., II, 157.
New England to Texas.

(B) **R. septentrionalis** Bd., 1854, Pr. Phil. Ac., 61.
Canada to Montana.

R. montezumae Bd., 1854, Pr. Phil. Ac., 61.
City of Mexico.

R. virescens Kalm, 1761, Resa N. Amer., III, 46 (*halecina* auct.).
Mexico; United States and northward.

(B) **R. berlandieri** Bd., 1859, Mex. Bd. Surv., Rept., 27, pl. 26, f. 7–10.
Mississippi valley; Dakota to Mexico.

(C) **R. nigricans** Hallow., 1854, Pr. Phil. Ac., 96.
El Paso creek, California.

(D) **R. areolata** B. & G., 1852, Pr. Phil. Ac., 173.
Texas.

(E) **R. capito** LeC., 1855, Pr. Phil. Ac., 425, pl. 5.
Illinois to Florida.

(F) **R. sinuata** Bd., 1854, Pr. Phil. Ac., 61 (*circulosa* Jord.).
New York to Michigan.

(G) **R. lecontei** B. & G., 1853, Pr. Phil. Ac., 301.

R. palustris LeC., Ann. Lyc. N. Y., I, 282.
Missouri to the Atlantic.

R. silvatica LeC., l. c., 282.
Mississippi valley to Atlantic.

(B) **R. cantabrigensis** Bd., 1854, Pr. Phil. Ac., 61.
Canada to Saskatchewan; New England.

(C) **R. aurora** B. & G., 1852, Pr. Phil. Ac., 174.
California; Oregon.

R. pretiosa B. & G., 1853, Pr. Phil. Ac., 378.
Puget sound.

R. maculata Brocchi, 1876, Bull. Soc. Philom. (7), I, 178. ?
Mexico.

R. adtrita Trosch., 1865, Wirbelth. Mex., 82 ?
Mexico.
R. pachyderma Cope ?

ENGYSTOMATIDAE.

ENGYSTOMA Fitz., 1826, Neue Class., 65.
E. carolinense Holbr., 1838, Herp., I, 83, pl. 2.
South Carolina to Missouri and Florida.
E. ustum Cope, 1866, Pr. Phil. Ac., 131.
Mexico.
E. elegans Blgr., 1882, Cat. Batr. Sal., 162.
Cordova, Mexico.
E. rugosum D. & B., 1841, Erp., VIII, 744.
Mexico.

CYSTIGNATHIDAE.

HYLODES Fitz., 1826, Neue Class., 38.
H. ricordii D. & B., 1841, Erp., VIII, 623.
Southern Florida.
Lithodytes latrans Cope, 1878, Amer. Nat., 186 ?
Texas.
Syrrhophus marnockii Cope, l. c., 253. ?
Texas.
H. berkenbuschii Pet., 1869, Mb. Brl. Akad., 879.
Mexico.
Batrachyla longipes Bd., 1859, Mex. Bd. Surv., II, pl. 37.?
California to British America.

BUFONIDAE.

BUFO Laur., 1768, Syst., 25.
Rana lentiginosa Shaw, 1802, Zool., III, 173.
North Carolina to Colorado and Florida.
(B) **B. americanus** (LeC.) Holbr., Herp., V, 17.
Nova Scotia to Dakota, and southward.
(C) **B. fowleri** Putnam, Rep. Peab. Ac.
This is an **americanus** of moderate size and with frontal ridges low, close together, and nearly or quite parallel. Voice peculiar.
Manitoba to Winnipeg; Massachusetts.
(D) **B. cognatus** Say, 1823, Long's Exp., II, 190.
Arkansas; Colorado; Dakota.
(E) **B. frontosus** Cope, 1866, Pr. Phil. Ac., 301.
Colorado; Utah; New Mexico.

(F) **B. dorsalis** Hallow., 1852, Pr. Phil. Ac., 181.
New Mexico.
(G) **B. speciosus** Grd., 1854, Pr. Phil. Ac., 86.
Texas; New Mexico.
(H) **B. microscaphus** Cope, 1866, Pr. Phil. Ac., 301.
Colorado; Utah; California.
(I) **B. pictus** Yarr., 1875, Wheeler's Rept., V, 522.
Utah.
(J) **B. mexicanus** Broc., 1879, Bull. Soc. Philom. (7), III, 23.
Mexico.

B. punctatus B. & G., 1852, Pr. Phil. Ac., 173.
Texas; Mexico; Arizona.

B. debilis Grd., 1854, Pr. Phil. Ac., 87.
Tamaulipas.

B. halophila B. & G., 1853, Pr. Phil. Ac., 301.
California.

B. columbiensis B. & G., 1853, l. c., 378.
Oregon and Washington Territory.

B. valliceps Wiegm., 1833, Isis, 657.
Louisiana to Mexico.

B. compactilis Wiegm., l. c., 661 ?
Texas; Mexico; Peru.

B. dipternus Cope, 1879, Am. Nat., XIII, 437 ?
Montana.

B. monksiae Cope, 1879, Pr. Am. Phil. Soc., 263 ?

B. copeii Yarr. & Hensh., 1878, Rept. & Batr., W. 100 Merid., 4.
Selkirk and James bay, British America.

B. beldingii Yarr., 1882, Pr. U. S. Mus., 441.
La Paz, California.

B. quercicus Holbr., 1842, Herp., V, 13.
North Carolina to Florida.

B. occipitalis Camerano, ——, Atti Ac. Torin, 889, XIV ?
Mexico.

B. bocourti Broc., 1876, Bull. Soc. Philom. (7), I, 186.
Totonicapam, Mexico.

B. argillaceus Cope, 1868, Pr. Phil. Ac., 138 ?
Western Mexico.

HYLIDAE.

CHOROPHILUS Baird, 1854, Pr. Phil. Ac., 60.

Hyla triseriata Wied., 1839, Reise N. Amer., I, 249.
New Jersey; Colorado.

(B) **Helocaetes clarki** Bd., 1854, Pr. Phil. Ac., 60.
Texas.
(C) **C. triseriatus** subspecies *corporalis* Cope, 1875, Check-list ?
New Jersey.
Rana nigrita LeC., 1824, Ann. N. Y. Lyc., I, 282.
South Carolina; Florida.
Cystignathus ornatus Holbr., 1842, Herp., IV, 103, pl. 25.
South Carolina; Georgia.
Hylodes ocularis Holbr., l. c., 137, pl. 35.
South Carolina; Georgia.
C. copii Blgr., 1882, Cat. Bat. Sal., 334.
Georgia.
C. septentrionalis Blgr., l. c., 335, pl. 23, f. 1.
Great Bear lake.
C. verrucosus Cope, 1877, Pr. Am. Phil. Soc., 87 ?
Florida.

ACRIS D. & B., 1841, Erp., VIII, 506.
Rana gryllus LeC., 1824, Ann. N. Y. Lyc., I, 282.
Illinois; North Carolina to Florida.
(B) **A. crepitans** Bd., 1854, Pr. Phil. Ac., 59.
Maine to Dakota and Texas.
(C) **A. achetae** Bd., l. c., 59.
Key West, Florida.
(D) **A. bufonia** Blgr., 1882, Cat. Bat. Sal., 337.
New Orleans.

HYLA Laur., 1768, Rept., 32.
Calamita cinerea Schn., 1799, Amph., 1, 174.
This is the *H. carolinensis* of authors, = the cinereous frog of Pennant, 1792, Arct. Zool., II, 331.
North Carolina to Florida.
(B) **H. semifasciata** Hallow., 1856, Pr. Phil. Ac., 306.
South Carolina; Texas.
H. affinis Bd., 1854, Pr. Phil. Ac., 61. ?
Sonora.
H. gratiosa LeC., 1856, Pr. Phil. Ac., 146, pl. VI.
Georgia; Florida.
H. versicolor LeC., 1824, Ann. Lyc. N. Y., I, 281.
Texas; Wisconsin; Massachusetts.
H. femoralis Daud., 1803, Rainettes, 15, pl. 1, f. 1.
Georgia; Florida.
H. squirella Daud., l. c., pl. 14, f. 3.
South Carolina; Florida.

H. andersoni Bd., 1854, Pr. Phil. Ac., 61.
Maryland; South Carolina.

H. eximia Bd., l. c., 61.
New Mexico; Mexico.

H. regilla B. & G., 1852, Pr. Phil. Ac., 174.
Mexico; Oregon; Nevada.

H. baudinii D. & B., 1841, Erp., VIII, 564.
Texas; Central America.

H. nigropunctata Blgr., 1882, Cat. Batr. Sal., 366.
Cordova; Jalapa; Vera Cruz.

H. crassa Broc., 1876, Bull. Soc. Philom. (7), I, 130.
Mexico.

H. plicata Broc., l. c.
Mexico.

H. cadaverina Cope, 1866, Pr. Phil. Ac., 84 ?
California.

H. arenicolor Cope, l. c.
Utah; Sonora.

H. curta Cope, l. c., 313.
Lower California.

H. miotympanum Cope, 1863, Pr. Phil. Ac., 47 ?
Jalapa, Mexico.

H. gracilipes Cope, 1865, l. c., 195 ?
Northeastern Mexico tableland.

H. bistincta Cope, 1877, Pr. Am. Phil. Soc., 87 ?
Vera Cruz.

Hylodes pickeringii Holbr., 1842, Herp., IV, 135, pl. 34.
Maine; Illinois; South Carolina.

PHYLLOMEDUSA Wagl., 1830, Syst. Amph., 201.

P. dacnicolor Cope, 1864, Pr. Phil. Ac., 181.
Colima.

PELOBATIDAE.

SCAPHIOPUS Holbr., 1838, Herp., I, 85.

S. solitarius Holbr., l. c., 85, pl. 12.
Massachusetts; Florida; Mississippi.

(**B**) var. **albus** Garman, 1877, Pr. A. A. A. S., Buffalo meeting, 194.

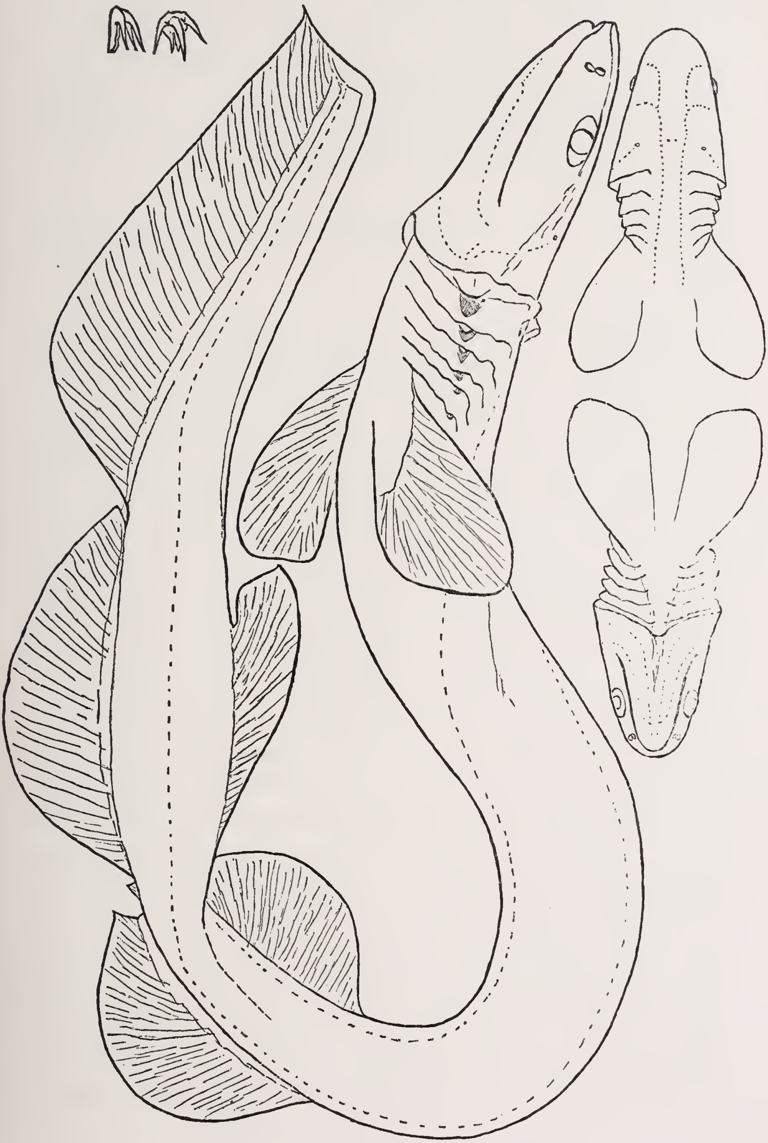
Average size less than that of preceding. Brown of the back lacks the red or chocolate tinge. Readily distinguished by the great amount of white on back, flanks and upper surface of limbs. The white forms spots or vermiculations which coalesce into bands of irregular shape and extent.

Key West, Florida.

S. couchii Bd., 1855, Pr. Phil. Ac., 52.
Texas; Utah; California.
(B) **S. varius** Cope, 1863, Pr. Phil. Ac., 52.
Utah; Lower California.
(C) **S. rectifrenis** Cope, l. c., 52.
Tamaulipas; Coahuila.
S. multiplicatus Cope, l. c.
Mexico.
S. hammondi Bd., 1859, P. R. R. Rep., X, pt. 4. 12, pl. 27, f. 2.
California.
S. bombifrons Cope, 1863, Pr. Phil. Ac., 53.
Missouri; Nebraska; Texas.
S. dugesi Broc., 1879, Bull. Soc. Philom. (7), III, 23.
Mexico.
Spea stagnalis (Cope) Yarr., 1875, Wheeler's Rep., V, 525, pl. 25, f. 6–8.
New Mexico.
Scaphiop. intermontanus (Cope) Yarr., 1883, Checklist, 26. ?

AN EXTRAORDINARY SHARK.

BY SAMUEL GARMAN.



CHLAMYDOSELACHUS ANGUINEUS.

Measurements.—Total length 59.5; snout to angle of mouth 4.5, to back of skull 4.25, to occipital pores 3.9, to end of gill covers 7., to end of pectorals 14.25, to vent 35.5, to base of ventrals 32., to end of ventrals 38.6, to base of anal 39.75, to end of anal 47.6, to base of dorsal 42.25, to end of dorsal 47.75, to base of caudal 48.5; greatest width across ventrals 7., greatest width across caudal 5., greatest width across dorsal and anal 6.5, greatest circumference of body 11.5, width of head across eyes 3.5, width of teeth between the outer prongs (length of longest prong little less) .25 inches.

Rows of teeth $\frac{14}{13} \cdot \frac{0}{1} \cdot \frac{14}{13}$.

Rays on hyomandibular and ceratohyal (first branchial arch) 22, on second arch 15, third 14, fourth 12, fifth 9, sixth 6, and on the seventh none.

Hab., Japanese seas.

Description. Body very long, slender, eel-like, increasing in size comparatively little anteriorly, compressed near and behind the vent, which is in the posterior half of the total length. Head broad, wider than high. Crown slightly convex forming a rather sharp angle with the snout and sides of the head, from the eyes forward. Skull with an anterior foramen, beginning a short distance in front of a vertical from the front edge of the orbit, resembling that of *Raja*. Behind this, midway between the eyes, there is an elongate depression on the crown as of a second foramen, while on the occiput a little distance in front of the occipital pores a deep rounded depression indicates what is commonly called the second, the posterior foramen. Snout broad, rounded, hardly extending in front of the jaws, rather acute-angled or shovel-shaped at the top. Nostril moderate, vertical, separated by a fold from each side into an upper opening looking forward and a lower one looking backward, situated about midway from eye to end of snout and near the middle of the space from top of head to mouth. Eye moderately large, orbit elongate, near a vertical from the middle of the length of the mouth. Spiracle very small, over the hyomandibular; its distance behind the eye equal to that from eye to

end of snout. Mouth cleft very deep, slightly curved, extending as far back as the skull. Roof and floor of mouth covered with sharp scales, the former curving upward very strongly behind the teeth between the nostrils. Upper and lower jaws about equal in length. Lips without a groove or labial fold. Glossohyal cartilage (basihyal) prominent above the floor of the mouth and free at its extremity about half an inch, forming a tongue. Teeth small, similar in both jaws, several in each row in function at the same time, each with three long, smooth, curved, backward directed, slender, very sharp cusps — each of which bears some resemblance to a serpent's tooth. A small cusp on the base at each side of the central. Bases of teeth broad, extending inward about the length of the cusps, terminating in two prongs (see fig.) which, extending beneath the base of the next tooth, prevent the possibility of reversion or turning the cusps forward. Fourteen rows of teeth on each side on the upper jaws, no median series. A median row on the symphysis of the lower jaws, its teeth similar in size and shape to those of the thirteen rows on each side of it. Hyomandibular and ceratohyal closely and somewhat firmly connected with the jaws at the hinge or hinder angle of the latter. Branchial arches long, very slender, with sharp small scales on their inner edges. Without dissecting, twenty-two branchial rays can be counted on the hyomandibular and ceratohyal (the first arch) and on the succeeding six arches, in order, 15, 14, 12, 9, 6, and 0 respectively. In most cases the outer extremities of the rays are produced in a sharp flexible point beyond the adjacent margin of the gill covers. Gill openings very wide, oblique, the opposite series very narrowly separated on the throat, the fourth in front of a vertical from the pectoral and the fifth and sixth extending back above the shoulder. A broad opercular flap covers the first

branchial aperture and is continuous and free across the isthmus, forming a frill or ruffle ; it is held in place and prevented from turning forward by a thin fold or wall of membrane, near an inch in height, attached immediately beneath the middle of the basihyal. The external distribution of slime-canals is about as follows : starting above the nostril in front of the eye a line turns backward along each side of the skull and, after receiving a branch from behind the eye, continues along the middle of each flank to the extreme end of the vertebral column in the tail, where it makes an abrupt turn downward for about a quarter of an inch ; under the chin on each side, a line runs along the mandible and curving upward disappears behind the angle of the mouth ; a branch of this, beginning nearly on a vertical beneath the middle of the space between eye and nostril, runs farther from the mouth and turning upward near the margin of the opercular flap after receiving a short branch behind the angle of the mouth, continues to a point a very short distance behind the spiracle, a small branch coming into it near the end from the direction of the corner of the mouth. Pectorals moderate, broad, rounded. Dorsal comparatively small, its posterior extremity extending as far back as that of the anal, angle blunt. The upper margin of the dorsal is armed with a series of enlarged, compressed, chisel-shaped scales, which extends forward on the back to a vertical from the vent, a few of the anterior being horizontally flattened. Ventrals large, broad—a little broader than long, rounded, posterior angle acute. Anal broad, long, rounded, acute-angled posteriorly. Caudal long, very broad, rounded anteriorly, posterior angle acute—produced into a filamentary point, margin very thin or membranaceous. Above the muscular vertebral portion of the tail there is a narrow expanse of fin, widening backward, the edge of which is armed by a

sharp series of chisel-shaped scales, and extended downward behind the end of the vertebral column, where it becomes about three-sixteenths of an inch in width. That it is the dorsal portion of the fin which descends is proved by the change in the direction of the points of the scales and of the mucus canal. The dorsal portion of the fin is plainly indicated on the hinder margin of the tail about half-way down to the filamentary point. The chisel-shaped scales are in reality formed from two series (one belonging to each side of the body) which have coalesced. Though small and harsh to the touch the scales on the body are not sharp; they offer about the same resistance from whatever direction the finger may be passed over them. On the tail, however, they are very sharp and the points are directed backward. Along the edges of the canals on both body and tail the scales are compressed and flattened; they form the only cover or protection for these organs, which in the specimen described have the appearance of long seams or grooves. On the skull these canals do not stand open as on the rest of the body. Near the mouth and especially toward its angle the scales are larger and more prominent. Under the middle of the belly, the skin forms two closely approximated rolls or ridges separated by a groove, and inside of these the muscle is thicker than towards the flanks. Intestine very small, valve spiral. Abdominal pores opening behind the vent, protected by a fold. Cartilages soft and flexible as those of *Somniosus* or *Selache.* Uniform brown, darker at the thin margins of the fins. Specimen described, a female, apparently adult, purchased by the Museum of Comparative Zoology from Professor H. A. Ward, who gives Japan as the locality.

The accompanying outlines are taken from the animal as it lies on the belly showing the back of the middle of the

body and the sides of the head and tail. The smaller sketches show the upper and lower surfaces of the head. The smallest figures give the outlines of a tooth viewed from above and from the sides.

From the foregoing it appears that there is neither genus nor family to which the species described may properly be assigned. The characters given below are selected for provisional diagnoses.

Chlamydoselachus. Branchial apertures six. Opercular flap broad, free across the isthmus. Teeth similar in both jaws, with slender subconical cusps and broad backward produced bases. No teeth in the middle in front above; a row on the symphysis below. Mouth wide, anterior; no labial fold. No nictitating membrane. Fins broad, pectorals far in advance of the others. Caudal without a notch posteriorly. Gill arches slender, long, basihyal not wide. Intestine small.

Chlamydoselachidæ. Body much elongate, increasing in size very little anteriorly. Head depressed, broad. Eyes lateral, without nictitating membrane. Nasal cavity in skull separate from that of mouth. Mouth anterior. Snout broad, projecting very little. Cusps of teeth resembling teeth of serpents. Spiracles small, behind the head. One dorsal, without spine. Caudal without pit at its root. Opercular flap covering first branchial aperture free across the isthmus. Intestine with spiral valve.

Remarks. Such an animal as that described is very likely to unsettle disbelief in what is popularly called the "sea serpent." Though it could hardly on examination be taken for anything but a shark, its appearance in the forward portion of the body, particularly in the head, brings vividly to mind the triangular heads, deep-cleft mouths, and fierce looks of many of our most dreaded snakes. In view of the possible discoveries of the future, the fact of the existence of such creatures, so recently undiscovered, certainly calls for a suspension of judgment in regard to the non-existence of that oft-appearing but elusive creature, the serpent-like monster of the oceans.

Generally the attitude of ichthyologists in respect to the belief in unknown sea monsters is much the same; they are inclined to accept it but are waiting more definite information. A couple of years ago Professor Baird in a conversation on the subject drew a sketch of a strange creature, captured and thrown away by a fisherman on the coast of Maine, which might be readily considered by the ordinary observer as a form of "the serpent." It was some twenty-four feet in length, ten inches in diameter, eel-like in shape, possessed of a single dorsal placed near the head, and had three gill openings. The question was "is it a shark?" In several respects it resembled an eel rather more. An outline and the correspondence in relation to it have recently been published in the Proceedings of the Fish Commission.

Notwithstanding the possession of peculiarities which prevent its entrance into any of the known families of the order, the subject of the present communication is a veritable shark. A diameter of less than four inches to a length of five feet marks one of the slenderest of the tribe. Whether it attains much greater length we can only judge,

from the structure and apparent age of the specimen, to be probable. The delicate margins and filaments of the fins are those of an inhabitant of the open sea or considerable depths. Bottom feeders are provided with larger spiracles and the fins usually show signs of wear. Rapidity of movement is suggested by the large amount of surface in the posterior fins. It is probable, however, that the large fins, being so far back, are of importance as support for the body when the anterior portion is quickly plunged forward to seize the prey; that is, they secure a fulcrum from which the animal may strike like a snake. The anterior fins (pectorals) being only of moderate size are yet ample for balancing or directing the body when in motion however rapid.

There is a correspondence between the size of the gill openings and that of the mouth; no matter how widely the latter may be opened when rushing upon the prey, the immense branchial apertures allow the water to pass through without obstruction. Favoring the idea of rapidity of movement still further are the peculiarities in the structure of the nostrils. By means of a fold from each side of the vertically elongated nostril it is divided into what appears to be two nasal apertures. Of these the upper looks forward and catches the water as it is met turning it into the cavity upon the membranes of the interior; while the lower opens backward allowing the water to escape after passing over the olfactory apparatus. In case of the upper opening it is the hinder margin that stands out farthest from the head and in the lower aperture it is the forward edge that is prominent. In fact the structure is such that the slightest forward movement will send a current of water in at the upper portion of the nostril and out at the lower while a move backward will simply reverse

the order making the current enter below and escape above. In most Selachians this current is secured by means of the nasal valve, which covers about half of each nostril.

The teeth are constructed for grasping and from their peculiar shape and sharpness it would seem as if nothing that once came within their reach could escape them. Even in the dead specimen the formidable three-pronged teeth make the mouth a troublesome one to explore. Points of teeth in perfect preservation, shape of the cusps, and the structure of the small portion of the intestine left by the captor, leave little room for doubt that the food of the creature was such as possessed comparatively little hardness in the way of the mail or other armature.

No other shark of which we know has the opercular flap free across the throat. In this particular it recalls the fishes. There is a certain embryonic look about the species, as others who have seen it also remark, that calls for a comparison with fossil representatives of the Selachians. Among them I have been unable to find anything which might be considered at all near. In *Cladodus* of the Devonian there is a form with teeth somewhat similar, a median and two lateral cones on each tooth, but the cones are straight instead of curving backward, and the enamel is grooved or folded instead of smooth. However, the type is one which produces the impression that its affinities are to be looked for away back, probably earlier than the Carboniferous, when there was less difference between the sharks and the fishes.

A SPECIES OF HEPTRANCHIAS SUPPOSED TO BE NEW.

BY SAMUEL GARMAN.

HEPTRANCHIAS PECTOROSUS.

Total length 16, snout to caudal 10.375, snout to anal 8.25, snout to dorsal 7.1, snout to vent 6.75, snout to end of pectoral 5, snout to angle of mouth 2, and snout to mouth 0.8 inches.

Hab., Patagonia.

Description. Body elongate, compressed posteriorly, heavy and broad in the anterior third of its length, chest broad. Head broad, short, somewhat depressed, snout and facial angles rounded, blunt. Nostril, anterior, more than half-way from the eye to the end of the snout, in the upper half of the distance between top of head and mouth. Eye moderate, without a nictitating membrane, situated about the middle of the length of the head. Spiracle very small, in front of the upper angle of the first gill opening, half-way to a vertical from the eye. Mouth very large, inferior, with a thin labial fold which extends along the lower jaw nearly half-way to the symphysis. Teeth compressed, unlike in the upper and lower jaws, which both have teeth on the symphysis. Roof and floor of mouth with compressed usually five-cusped scales, like shagreen. The tooth between the series of the upper jaws is sharp pointed, slightly oblique and resembles those on its left, as it is on that side the small notch appears at its base. On each side of this tooth there is a series of seven, the medial of which bears a small cusp at the forward portion of

the base which is followed by a long sharp one and this in turn by one or two smaller ones. Behind the seven, toward the angle of the jaws, there are a number of very small ones. On the lower jaws the teeth are much broader, that on the symphysis is small and bears most of its notches on the left side; on each side of it there is a series of six, each of which has one to two small, followed by four moderate sized, cusps, the anterior of the four being little if any longer than the other three; and, in cases, there is also a small cusp on the posterior portion of the base. As in the upper series there are very small teeth in the hinder portion of the series. Gill openings seven, wide, all in front of the pectoral, the series separated on the throat by a space nearly as wide as that between them back of the head; the width of the openings, and of the spaces between them decreases toward the pectoral. Pectorals nearly as broad as long, angles rounded, posterior margin slightly indented. Width across both ventrals less than their length. The posterior inner portion of each ventral is a strong fold, opening toward the body, and in it is hidden the clasper. Dorsal rather small, beginning above the posterior extremity of the ventral and extending a little beyond a vertical from the middle of the anal, posterior margin indented, lower angle produced, blunt. Anal smaller than the dorsal, beginning under the middle of the length of the latter. Tail long without a pit at the root, armed on the upper edge by three series of enlarged (thickened and broadened) scales. Caudal rather narrow, widest anteriorly. Scales carinate, where they have not been rubbed, with a long sharp central point and, on each side of this, one or two small ones.

Brownish, more or less faintly blotched with darker on back and flanks. Type in Mus. Comp. Zool., Cambridge, Mass.

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PIGEONS AND THE PIGEON FANCY.

BY WM. G. BARTON.

The pigeon family, in the widest sense, includes a multitude of species, many living in the tropics and displaying the gorgeous colors characteristic of the birds of hot climates. But the wild species of pigeons which inhabit Old and New England are few in number. In the former, we find *four* species, viz.: the Blue Rock Dove, which we shall speak of again, the Ring Dove, which is the commonest wild pigeon of England, the Stock Dove — once considered the stock whence all domestic pigeons — and the Turtle Dove. In New England are *two* species only: the common Wild or Passenger Pigeon, and the Carolina Dove. The beautiful little Collared Turtle Dove, called also Ring Dove and Laughing Dove, common in both countries as a pet, is not to be confounded with these.

Science has turned her scrutinizing eye sharply upon pigeons; and Mr. Darwin took the domestic pigeon for his chief typical illustration of the variability of domestic animals, and made them contribute a surprising

array of facts toward the support of his grand and audacious theories of animal life. His opinion that all the varieties of tame pigeons have descended from one species, finds acceptance I believe with most scientists, although it has not lacked warm contestants, and certainly, to superficial observers, may well appear absurd. Those who are interested in the question should read that one of the several monuments of the great naturalist's patience and concentration, "The Variation of Animals and Plants under Domestication." The wild species assigned this post of honor is the one first mentioned—the Blue Rock Pigeon (*Columba livia*). This bird is very similar in appearance to that variety of our common pigeon which is slaty-blue with two well-defined dark bars across each wing. It is still found in Great Britain, particularly along the rocky shores of Scotland. Wild rock pigeons in other parts of the the world, as in India and Italy, differing somewhat in appearance from the British bird, are classed as the same species. It is interesting to notice how often the light bluish wing with the two bars appears among the fancy breeds. This marking is especially common in the offspring of crosses between two varieties.

The Blue Rock pigeon's nearest brother, and a variety which required neither the cunning interference of man nor long ages to produce, is the common Dove-house pigeon, with which, mingled in some degree with other blood, Salem and other cities are, in the words of a Salem clergyman, "infested." But, if we follow Mr. Darwin, we must also consider as *Columba livia*, birds so mutually diverse as the pouter, the tumbler, and the fantail. Our common pigeon is found all over Europe, and is the kind used in the cruel shooting-matches, which should be prohibited. It is so abundant that the swiftness of its flight and the general beauty of its plumage,

especially in the "iris" of its burnished neck, are apt to escape our notice.

Pigeons have been associated with mankind for uncounted ages. Noah's dove and the frequent references to pigeons in the Scriptures are familiar to us all. The earliest record of the domestic pigeon refers to the Fifth Egyptian Dynasty or 3,000 B. C. But, leaving that out of account, the ode to the carrier by Anacreon, written in the fifth century, B. C., and the complaints of Varro who was born 116 B. C., and of Columella, living about the year 1 A. D., regarding the extravagant prices paid for fancy pigeons by their contemporaries, are allusions to pigeons old enough to make the brownest crumbling document in this building seem a thing of yesterday. And there may be somebody here who, learning that £100 is paid for a pair of carriers at the present day, and that long lists of pigeon genealogy are printed, would shake hands with old Pliny across eighteen centuries, and lament as he did when he said: "Many are mad with the love of these birds; they build towers for them on the tops of their roof, and will relate the high-breeding and ancestry of each, after the ancient fashion. Before Pompey's civil war, L. Axius, a Roman knight, used to sell a single pair of pigeons *denariis quadringentis*." This sum has been estimated £12 18s. 4d.

Among the Orientals, pigeons have always been favorite pets. There are thirty Sanscrit names for them, and half as many Persian. India and China are old pigeon countries. In fact, we believe that all civilized, and many half-civilized, peoples have prized the pigeon. Besides the countries mentioned, there come readily to mind, as associated with this fancy, Egypt, Morocco, Turkey, Austria, Italy, Spain, France, Russia, the United States, and preëminently Germany, Belgium, Holland and Great

Britain. The dove which whispered into the Great Prophet's ear has endeared this bird to Mussulmans; Russians feel at this late day a practical affection toward them because of the service rendered at the Deluge; and the many associations of the dove with Scripture have kept alive a sentiment at least in their favor throughout Christendom. Large numbers are publicly fed every day in the great square of Venice; flocks soar across the smoky sky of London; the streets of St. Petersburg, Cairo, and Constantinople abound in them, tame and fearless. Among the rafters in the dock-sheds of New York City live hundreds of pigeons, protected and cherished by salt and stevedore; and the spillings from the nose-bags of the horses in Boston are devoured by denizens of loft, cornice, and church-tower; while amid the smoke and din of the railway station in Salem doves rear their young.

In feudal days the barons only were allowed to keep pigeons, which they suffered to prey upon the crops of their tenantry, who had no redress. So that, in France especially, we find hard words spoken against the dovecotes — those towers of masonry in which these birds were lodged. These dovecote pigeons were no doubt at first the "blue rocks," which had been captured in their native haunts.

The pigeon fancy must be considered strictly *a fancy*. Many men make it a business, of course, and a pigeon pie is a pleasing incident; but the bald questions "Does it pay?" and "Do you eat them?" are considered almost insulting by the true fancier, and are a sign that the questioner must experience, in respect to this subject, a sort of new birth before he can be enlightened. The fancy, then, is æsthetic, allied to that for roses, dahlias and tulips; and I will venture to assert, that in grace of form, and beauty of color and marking, those flowers have in

pigeons formidable rivals. To the boy the pigeon is a pretty pet; to the man it becomes the object of deep thought, of persevering training, and of patient experiment.

Yes! to the boy, pigeons are the royal pets; and thereafter, the caged squirrel, the penned-up toad, the tethered tortoise, lose their charm. Captives are they — yet at liberty, and such a liberty — not of the earth, but of the heavens. They wander, not to catch grasshoppers in the mowing lot, but to soar with exultant freedom into the skies, still, as their proud owner knows, bound fast to the loft by the ties of home. To the urchin everything winged and hard to catch has especial charms, whether butterfly, bat, or bird. And the craving for possession grows so strong, that the black-barred, blue-checkered, brick-red-checkered, white, or variously pied, common pigeons of our streets and yards are enticed into the noose or under the sieve, if only for the short-lived pleasure of holding in the hand that throbbing form which just now cleaved the air, or of pressing to the cheek or lips the soft wing which has whistled so often overhead. The rapture felt, when the coop is being prepared; when the first live pigeons are owned; at the discovery of the first white egg; or at the return of the birds after their taste and test of liberty,—only those who have felt it know. The speaker recalls the time when, although then opposed as now both from inclination and principle to early rising, he hastened to his loft at five in the morning, where seated on a hard box he spent an hour or two in watching the indoor habits of his pigeons. Sometimes I carried on evening observations by lantern light. Even now, I occasionally see in dreams such ideal pigeons as are figured in the books, and with that light upon their feathers which never was on sea or land.

Pigeons pair, like the singing-birds; but, instead of mating for the season, remain paired year after year, even, as a rule, for life. I say *as a rule* because there are frequent exceptions; and the constancy of the dove has been greatly exaggerated, as they occasionally desert one another to choose more congenial mates, and are by no means *always* faithful to the vows made at billing, even when the partnership is continued. So are their meekness and gentleness largely imaginary. It is, I fear, the soft, plaintive voice of the pigeon that has done much for its reputation. There could scarcely be a more striking illustration of a quarrelsome disposition, prone to pick up a row whenever possible, than is afforded by some cock pigeons. Such a bird will take up his station at the entrance of a loft, and do his best to prevent the passage in or out of any inmate, rushing to and fro with malicious cooing and vicious strokes of his bill. Such a pigeon often takes possession of the whole side of the room, comprising many more nests than he can possibly use, and maintains his position until actually whipped in a free fight with some other cock. A pigeon frequently acts to perfection the dog in the manger, perching upon the food box or the bath solely to keep other pigeons away. This is hardly exceptional, unless in degree. No bird is more jealous of his rights and privileges, and they are all greedy and all will fight — or run. I have watched with some excitement fights over a nesting place, which lasted for many minutes. They approach one another sidewise, holding on high the off wing in a threatening way, and striking with the one next their rival, and also with their beak. It is highly amusing to see two that are about equally matched, in a nesting box, wrestling, each trying to pitch his antagonist out and not to be pitched out himself, so that they turn round and round

or stand as still as a Rogers group, tightly braced with outspread wings and legs. That they are seldom much injured in these fights is only because they are poorly armed. A squab which has tumbled to the floor is not unfrequently terribly lacerated—sometimes even killed by old birds; and a sick pigeon is invariably persecuted with vehement malice. I regret to disturb any long cherished notion in the minds of my hearers, but am thus in the fashion in these iconoclastic times. You will find very much in these birds to compensate for a character often so unlovely; and their habit of generally mating for life, and always very fondly, remains a remarkable fact.

The perpetuation and improvement of existing varieties and the formation of new ones depend upon the fact that pigeons very kindly accept mates chosen by their owners, so that they may be made to mate according to the points possessed by the proposed parents and desired in the offspring. Many pages of tedious detail have been written as to what birds should be mated to produce a given result. As the French in roses, the Dutch in bulb flowers, so, for example, have the Germans shown marvellous skill in the production of variously marked and colored pigeons.

A cock and hen pigeon placed in a cage together, will generally mate in a day or two, unless the hen whip the cock. In which case, a few days sole possession of the cage will commonly furnish him with sufficient courage to bring the hen to submission. Two cock pigeons may mate, when males are too numerous, and, if given eggs, rear young; and females have been known to do the same, each laying two eggs in the nest, on which they sit with amusing patience. The nest is generally the choice of the cock, if not of the fancier. He flies into it, scratches about or crouches perfectly motionless and calls softly, louder and louder, to his mate, peeping out now

and then to see if she responds. Probably she soon flies into the nest, coos softly in reply, and caresses his head gently with her bill in the most affectionate and delicate manner. Perhaps she has brought a stick or straw. But, at any rate, he soon flies off to fetch building material to her, which she arranges with great care, often taking it directly from his beak. These meetings are always accompanied by short, confiding coos. The nests vary greatly. Some pairs work with great industry, and build a toppling dangerous structure; others are content with a dozen sticks, and deposit the eggs upon the bare board or earthen nest pan. Two eggs only are laid, the great fecundity of pigeons depending altogether upon the number of the broods, which among good breeders may amount to ten or eleven a year. For several days before the eggs are laid, the cock follows the hen from place to place, giving her little peace except when she is on the nest. The first egg is laid in the late afternoon, and after two nights and a day have passed, the second one is placed by its side, probably in the forenoon. Then begins incubation in earnest, more and more assiduous as the days go on. In all these matters, the cock takes an affectionate and unaffected interest, perching near by, communicating frequently, and assuming an important share in the labor of incubation. He goes on to the nest in the middle of the forenoon, is cordially welcomed by the hen, who carefully gets off the nest and seeks for food, recreation, and exercise, while he as carefully adjusts himself with an air of great comfort to await his mate's return, which will be in four or five hours. This time may vary slightly, but at night the nest is always occupied by the female. In about eighteen days after the second egg, the "golden couplets are disclosed," thinly covered with a yellow down, blind, and as helpless as young mice or sparrows. Now

we behold a marvel which distinguishes pigeons from other birds, and makes the old joke about pigeon's milk no joke at all. As in mammals the lacteal glands secrete milk at the birth of the young, so, at the hatching of the young pigeons, or rather at the time when they should hatch, the crops of both parents become thickened in structure, and secrete a milky liquid, which coagulates or curdles into something resembling curdled milk; and the young pigeon has his beak taken into the side of that of his parent, and receives this curdy nourishment, ejected by a sort of vomiting, against his wide under mandible. For this, his appetite is excellent, and such remarkable nutritive power does it possess, that squabs grow at a wonderful rate. For a while they are covered closely by the parents, and fed exclusively upon this "soft meat." But in a few days, they are left uncovered longer and longer, and the soft meat becomes mingled with half-digested food; and, after eight or ten days, it disappears altogether, the food being then merely softened by maceration in the crop of the parent. Later on, the old one, after eating heartily, directly swallows a copious draught of water and throws up his whole cropful into the maw of the young one, who is now fully feathered, perhaps flying from roof to roof, or running with outspread wings and a whistling note in pursuit of his father,—for the mother has probably weaned him, and is devoting her whole attention to a second pair of eggs.

Fanciers are in the habit of shifting eggs from one pair to another to afford valuable young the benefit of good nursing, and a large proportion of the highest bred birds are reared by foster-parents of a common sort. Young ones are sometimes given to several different pairs of nurses in succession, so as to be afforded more than one course of soft meat. Pigeons, like infants, may be brought

up by hand, and many a one, deserted after a week or so by his parents, has flourished, first on chewed cracker, then on grain and water (which they soon learn to take deftly from the human mouth); or has been fed literally by hand with soaked peas or corn. A large number of the pigeons sold for food in the London market have been stuffed by professional feeders, who charge a penny a dozen squabs for feeding them with millet or tares and water from their mouth. The crop is blown full in an instant and a whole meal thus given the astonished bird in almost the twinkling of an eye. The increase in weight of a young pigeon is thus given by an English clergyman. It was a young barb, and weighed at hatching one-half oz.

The following are its weights on the respective days:—

6th day	4½ oz.
7th "	5¾ "
9th "	8¼ "
12th "	10 "
18th "	11½ "
20th "	11¾ "
1mo.	12¼ " or a little more

than the mother. In four or five weeks the bird is flying about, and in six months or so is anxious to find a mate of his own.

Pigeons are great bathers, and common ones are often seen squatting in the puddles. During a shower, they sprawl about upon the roof, lying upon the side with one wing uplifted, that the drops may fall beneath it; and they sometimes remain out until completely drenched.

In their manner of drinking they resemble horses, sucking all they wish — a hearty pull — without raising the head, and, when very thirsty, immersing the beak nearly to the eyes.

They are fond of salt, and gather around a bit of salt fish, or peck day after day at the gravel where salt has been shaken from the table cloth.

Their fondness for hemp seed is like the greed of children for candy; and the wildest specimens may generally be quickly tamed by it, and made to eat from the hand and fly upon the head and shoulders of the feeder.

They are as individual as men. I can recall the faces and coos of certain pigeons, and have often recognized one among a flock of thirty by the voice alone. Some are docile, intelligent, less greedy; others pugnacious, stupid, and the very embodiment of selfish gluttony. Some, easily tamed, look trustingly at you; others of the same variety, have the eye of a wild Texas bull and refuse to come near, unless they are sure of hemp seed.

There are very many obstacles to successful pigeon-keeping. Hawks may catch them on the wing; cats bring bloody havoc into the loft, or snap up your choicest darling under your very nose; rats may eat eggs and young; lice in five or six species infest them; or disease ravage like Asiatic cholera. Some refuse to lay, others allow their young to starve. You may be surprised some fine day to find that your best yellow fantail has fallen down a chimney. Several pigeons have tumbled down two different chimneys in my house, and I was once obliged to rise at midnight to remove the fireboard in my chamber and admit a tumbler in this Santa Claus fashion, a *tumbler* indeed.

The homes of pigeons are of every kind, from the soap-box of the ten year old boy, to the elaborately furnished, heated, and daily swept apartments of the wealthy fancier. The best lofts in England, Scotland, and the United States would doubtless greatly surprise most of us by their beauty, costliness, and adaptation.

Many pigeon or columbarian societies, for the promotion of the fancy, exist in this country and in Europe. In London, at the present day, there is the National Peristeronic Society, which consists of one hundred members, and which holds an annual exhibition at the Crystal Palace. Of course there are multitudes of local societies.

The premiums and the notoriety offered by exhibitions afford the special inducements to fanciers to breed for points of excellence. The prizes are awarded by judges; and upon the standards adopted by the society, and the discretion of the judges depends, in some degree, what characteristics shall be demanded in certain varieties. So that, while the general character of a variety remains the same year after year, requirements as to minor points are constantly being modified. This subject sometimes gives rise to controversy.

[In describing the principal varieties of fancy pigeons, the speaker referred to the pictures upon the stage, and was not confined to manuscript. His remarks, somewhat abridged, were as follows.]

The Pouter is, in my opinion, the king of fancy pigeons, although this term has been applied to the carrier. The unsophisticated are apt to call him ugly, and at first sight he does bear a top-heavy look. But when we learn that his huge ball is simply inflated with air, he seems the lighter for it. Pouters are more cosseted and petted than any fancy pigeon. They are made very tame, handled often, stroked upon the back, and taught to "blow," and trip about or "play" as it is called, when addressed by the peculiar call which pouter fanciers utter. He is the most human pigeon, often assuming a nearly erect position, is intelligent, responsive, social, good-natured, comical. One comes to consider him a playful, sly rogue, ready for a frolic. If he does not swell up when

you want him to, it is an easy matter to put his bill into your mouth and blow him up, as a boy does a football. He will retain this air when set down, and strut about with as much satisfaction as if he did it himself. This habit of inflating the crop is in some degree common to all pigeons and affords them unmistakable pleasure, although once in a while the pouter may have a difficulty in discharging the air, perhaps even fall over backwards. They generally fly with much wing clapping and often with their crops fully inflated. When very hungry they are apt to gorge themselves, and all the pigeon books give instructions for hanging up a gorged pouter in a stocking leg. The pouter should be very tall and slender, with long legs that are properly feathered, long wings and tail, and a full round crop. He should be as perfectly marked as possible. There are blue-pied, black-pied, yellow-pied, red-pied, white, and other colors. Indeed most varieties of fancy pigeons are found of different colors. There is a small or "bantam" variety called the "pigmy" pouter. The Scotch are noted for their fine pouters. £300 has been paid for three pairs, and $135 for a yellow-pied hen, and probably even larger prices have been realized. Prices like these are not rare among rich and enthusiastic fanciers, and figures as astonishing may be quoted for all the more important varieties of fancy pigeons.

The Carrier is by many fanciers placed at the very head of the fancy, but it is not a favorite of mine. It has beauty, because it is a pigeon, and is very curious, but requires a high degree of culture to fully appreciate it. One must "be educated up to it," as the old saw-sharpener said to the man who objected to the music of his file. The carrier is now poorly named because, although its ancestors were undoubtedly used for the purpose which the name suggests, this fancy carrier is, by the highly devel-

oped eye and beak wattles, totally unfitted for long flights, its sight being so much obstructed that the best specimens cannot pick up scattered kernels of corn, but must be fed from a box. So the term "Homing Pigeon" or "Homer" has been applied to the actual carrier. The fancy carrier calls for more points of perfection than any other pigeon, and it is stated that twice as much money is annually spent for them as for any other variety. He is not tame nor petted like the pouter, but is naturally wild. He is large, powerful, and bold-looking. His neck should be long, slender but not tapering. His beak-wattles, eye-wattles, beak, head, legs, outline, must approximate to a given standard. His main distinguishing feature is his abnormally large beak-wattle, which looks as if a small cauliflower had been impaled upon his bill.

The Dragoon, often called the "Dragon," resembles the carrier, but has a smaller wattle which grows upon the upper mandible only. He is, I think, a much handsomer bird, being very symmetrical in form. They are good fliers and good nurses.

The Antwerp is a name given to an important variety of "Homing" pigeon, but there is also a sort called the "Show Antwerp," which is a fine bird, with lines to charm a sculptor, but with no very remarkable peculiarity.

The Barb was perhaps named from the country of Barbary. All the "wattled" pigeons are probably of Oriental origin. A Turkish pigeon called the Scandaroon much resembles the carrier. The barb has a broad square head, with a bright red surface of wattle around the eye, and a short, thick, bullfinch beak. It is highly prized, and is, like the foregoing and most of those to follow, of various colors.

The Mahomet is similar to the barb, but has a crest.

The Tumbler is so called because he tumbles; yet some

do not. In fact, tumblers may be divided into two classes: the Flying Tumblers, prized for their aërial performing, and Short-faced Tumblers, which are bred solely for certain peculiarities of appearance, without regard to their manner of flight. Tumbling, strictly speaking, is the turning of one or more complete backward somersaults during flight, so rapidly as not to impede progress, and often during an upward course. Good birds will tumble thirty or forty times a minute, and go over so quickly as to escape the notice of a person not used to watching them. The better spirits they are in, the more they tumble, appearing to take great pleasure in the act. But it is also true that among those called "House Tumblers," which tumble in the loft and are seldom let out, some individuals tumble if they rise a foot from the floor, and seem to dread the action; while occasionally an out-of-door tumbler loses control of himself and falls to the grouud. But the term tumbling does not mean falling, though some poor performers, especially young birds, do drop for some distance instead of going over. There is, however, a variety among tumblers called "Rollers," which drop through the air while rolling rapidly over and over. Collections or "kits" of flying tumblers are carefully trained to fly high in a compact flock. There is no more beautiful sight than a flock of these birds dashing off a roof, tumbling, rolling, and circling about higher and higher until almost or quite lost to sight. These flocks are often started off by flag waving, and called down by a whistle. They will remain aloft for hours, for seven hours even, never going out of sight, unless *upward*.

The Short-faced Tumblers are bred very small and plump, with a round head, and an exceedingly short beak. They are of very many colors, and among them are the Baldheads with a white head, and the Beards with a white

chin. All tumblers have short "faces," but the difference between the coarsest, "mousy," flying-tumbler and the high-bred, delicate, short-face is very great, and there are all grades between. The Almond Tumbler should be of a dark, rich yellow color (difficult to describe—it might be called a very light brown), dotted with small black spots, while the flight and tail feathers should each show distinct marks of yellow, black, and white. Some of the finest specimens remind one of a tulip. The almond birds often have young of other colors, which are used in breeding other almonds.

The Fantail or "Fan" is the best known fancy pigeon. It probably originated in India, and many have been brought home from Calcutta in Salem vessels. Ladies always admire the fantail; and a flock of pure white ones strutting over a lawn, or a collection of various colors, white, black, blue, yellow, red, pied, saddle-backed, feeding in a dense cluster like a bouquet of fine flowers, is worth going some distance to see. The old name for them is Broad-tailed Shaker. The term shaker is on account of the peculiar quivering motion of their necks when they strut. The tail of the common pigeon contains twelve feathers while that of the fantail has been known to carry forty. But erect carriage and symmetry of form are more to be desired than a great number of feathers, and most tails contain only between twenty and thirty.

[Only short notes had been written about the following varieties which were more or less fully described.]

The Frilled Pigeons, with a frill on the breast like a ruffled shirt-front, variously crested or plain-headed, include the following, with many sub-varieties of color, etc.: Turbit, Turbiteen, Satinette, Brunette, Bluette, Blondiette, and Owl.

The Jacobin, or "Jack," is apt to be poor, but when

good, is a most beautiful bird. Its distinguishing feature is an ample hood of colored feathers closely curving over its pretty white head.

The Trumpeter has a "shell" crest, a strange tuft of feathers at the base of the upper mandible, and very heavily feathered legs. He is named for his remarkable, long-continued, very amusing coo.

The Runt is the largest variety. It is bred solely for size. They weigh, per pair, between four and five pounds, and a single runt has weighed two pounds nine ounces.

The pigeons which are usually called "Toy Pigeons," are mostly of German origin. Most of them are included in the following list. It should be remembered that of many of these, there are several sub-varieties of differing colors: Magpie, Nun, Spot, White-spot, Helmet, Swallow or Tern, Fairy, Priest, Brunswick, Starling, Swiss or Crescent, Shield, Letz, Archangel, Ice, Fire, Suabian, Hyacinth, Porcelain, Victoria, Frill-back, Stork, Black-backed Gull.

The following varieties are Oriental: Swift, Lahore or Martin, Burmese or Florentine, Scandaroon, Damascene, Capuchin, Mookee, Goolee, Sherajee.

The Homing Pigeon, or the "carrier pigeon" of *literature*, must be distinguished from the carrier of the *fancy*. Pigeons have undoubtedly been used for many centuries to carry messages, and they are still used for that purpose; but at present, where one is used for carrying a message, thousands are flown in matches for a trial of speed. In considering them, it should be remembered that they fly only *to* their loft, being influenced solely by their desire to get home, and that they accomplish long distances only after a prolonged course of training. In the opinion of most persons who have carefully weighed the facts, their

wonderful feats may be altogether accounted for by their acute eyesight, good memory, and great power of endurance and speed. Cases have been cited which were thought to prove that they possess some mysterious power of divining the way home, but the weight of the evidence is decidedly against this notion. Fog and darkness invariably interfere with their return, and even a light fall of snow, which changes the appearance of the landmarks, has thwarted them. Journeys of three or four miles have been made on moonlight nights; but the offer made by Mr. Tegetmeier of £10 for any pair of pigeons which would fly twenty-five miles on a dark night (although thousands will fly two hundred and fifty miles in a day) was not met. The same gentleman took a pigeon, which had often flown fifty miles, a distance of five miles in a fog, and the bird very wisely remained upon a housetop until the fog cleared away.

The mystery of this homing power is lessened in some degree, when it is considered that a pigeon's power of vision is probably much greater than that of man, and that Mr. Glaisher, from a balloon one-half mile high over London, could see the River Thames all the way from Richmond to the Nore, and when a mile high, the cliffs at Dover seventy miles away. There can be little doubt that the very best-bred pigeon would certainly be lost if taken one hundred miles away for its first flight. Some birds which were twenty hours upon a journey of eighty-three miles flew over the same ground the second time in two. Even old ones, which have flown in races the previous season hundreds of miles in length, are never sent upon the longest journeys without being, in some degree, re-trained that year to refresh their memory.

Dragoons, Tumblers, Owls, and other varieties, have

been used as carriers; but the birds used for this purpose are prized solely for their flying, are generally the product of several judicious crosses, and so are of every variety of color. They must be muscular, close-feathered, with broad overlapping flight-feathers. Probably ninety-nine one-hundredths of the pigeons flown as carriers look much like common pigeons, being somewhat larger and stronger, stouter in build and beak, and having a sharp, intelligent look. When a pigeon, destined to be a homer, is two or three months old, he is taken a half mile or a mile away from his home and allowed to fly back. Then he is taken two miles, then say four, eight, sixteen and, perhaps, by this time ten, twenty, or thirty miles farther at each stage. Many birds are lost while being trained, thus carrying out the principle of the survival of the fittest.

A most remarkable opportunity for the use of carrier pigeons was afforded by the siege of Paris. Pigeons whose home was in that unfortunate city were sent out in balloons and subsequently loosed to make their way back as bearers of valuable official and private despatches. By paying a high rate of postage any person could send a message to a friend in Paris limited to a certain number of words. A very large number of despatches were set up in type, making a page as large as that of a newspaper. This was reproduced on a much reduced scale by photography upon a small piece of paper. One such piece, which was probably a fair sample, measured one and one-fourth inches by two and one-fourth, and contained two hundred and twenty-six despatches, the postage on which aggregated £100. This scrap of paper was placed within a bit of quill, which was securely attached to the shaft of one of the tail feathers of the appointed messenger. If the brave little pigeon safely ran the gauntlet of hawks, storms, fog, and German

sharpshooters, upon its arrival the despatches were interpreted with a microscope, distributed, or publicly displayed.

During the siege, sixty-four balloons came out of Paris containing ninety-one persons and three hundred and sixty three pigeons. Of the pigeons, only seventy-three found their way back; a few of them, however, two or three times, while one bird made six trips. A pigeon which was captured by the Germans and sent by Prince Frederick Charles to his mother, upon escaping from her loft after four years' confinement, returned to its Parisian home. Is it to be wondered at that the governments of France and Germany at the present time breed and keep in training great flocks of homing pigeons as a military measure?

Pigeon *racing* is now practised to some extent in this country. The English are moderately fond of it, but the headquarters for this sport is Belgium. Pigeon-flying is there the national sport. The King favors it and the government subsidizes it. There are said to be more of these pigeons in Belgium than there are inhabitants, or over 5,000,000. Every town, every village, has its society, and flights of three, four, and five hundred miles are common. Upon a single day there were sent 200,000 pigeons from Belgium into France, all to be liberated in races or for training. Sometimes the wonderful sight is afforded of 2000 or 3000 pigeons being liberated together. They are shipped in willow panniers or baskets, each containing about thirty. On Saturday, May 11, 1878, two special trains of seventy-three cars left Belgium for different stations in France, carrying 1740 hampers containing about 70,000 pigeons to be liberated the following day, Sunday. And, upon Sunday, May 19, 125,000 pigeons were loosed, 24,000 in one French city alone.

The races are generally flown under the direction of a

society. The distance from the starting point to each owner's loft is determined, and on the eve of the race, the birds, marked with their owners' name or number, are sent to the rooms of a committee, and there again marked with a cipher unknown to the owners. They are sent by rail with attendants to the starting point. When they are released the time is carefully taken, and various means are adopted to ascertain and verify the time of each bird's arrival at its home. In regard to the speed of these birds, Tegetmeier maintains that they can fly at the rate of three miles a minute. A pigeon has been known to make a journey in eight hours at an average speed of forty-five miles an hour. A French writer chose from the official reports of 300 great races the times of twenty-one birds, the circumstances of whose flight were particularly favorable for his purpose. The slowest of these, according to his estimate, flew 867 yards per minute, the three next to the fastest about 1440 yards, the very fastest 1780 yards. The journey of the latter occupied four and three fourths hours. A mile a minute for nearly five hours! Even this speed is greatly exceeded in short flights.

In 1865, thirty birds were flown from Liverpool to Ghent, 300 miles; they were liberated at 5.30 A. M., the first arriving at 5.50 that evening, after twelve hours and twenty minutes, averaging twenty-five miles an hour. Eight returned the same day; eight never returned.

In 1868, 1507 birds were liberated, July 18, 5 A. M. at Agen, about 500 miles from Brussels. The prizes, including those offered by the king, amounted to 19,000 francs. The following morning at 6.04, the first pigeon arrived, and the 216th came in at 10.30 the day after.

The longest race ever flown was from Rome to Belgium in 1868. 200 pigeons were liberated on July 22, at 4.30

A. M. All of them had flown home from the south of France but none had ever been farther. No bird reached home that month, nor on the first of Aug., nor the second, but on the third there arrived, at a town near Liege, the first messenger from the Eternal City, at 1.55 in the afternoon. If this pigeon had flown in a straight line, it must have crossed the Apennines and the Alps at an altitude of at least 7000 feet; but it is thought probable that it kept to the west of these mountains, skirting the coast and entering France by the way of Nice. The second bird came in on the same day at evening; the third, the day following, Aug. 4; the fourth, Aug. 6; the fifth and sixth, Aug. 10; seventh, Aug. 11; eighth, Aug. 12; ninth, Aug. 18, nearly a month after starting; and the tenth on Sept. 11, to Maestricht. Of the 200 birds liberated, 180 never returned.

The following facts, selected from a mass of material, may be interesting. Mr. Van Opstal, a Belgian, living in New York City, writes me that the longest distance flown in the United States is about 725 miles. The pigeon which performed this feat was owned in Cleveland, O., and was bred from a pair imported from Brussels. A Newark bird has flown about 700 miles, but the time occupied was about four weeks. In the summer of 1883, pigeons flew from Columbus, O., and arrived home at Newark, N. J., 460 miles away, on the same day they were liberated. Mr. Van Opstal writes that a distance of more than 550 or 600 miles seems to be too much for homing pigeons, from one to six weeks being spent in accomplishing that distance, and 75 per cent of the pigeons getting lost; while they often return 500 to 525 miles in a single day, and only 12 per cent get lost. They have flown from Steubenville, O., over the Alleghanies to

N. Y. City, 350 miles, in eight hours. A homer called Jupiter had a record substantially as follows:

Hatched in Antwerp		Aug. 1874.
Brought to America		Jan. 1875.
Philadelphia to New York		1875.
" " " "	(silver cup)	1876.
Chester, Pa. to N. Y.	(1st prize)	1877.
Elkton, Md. to N. Y.		"
Baltimore to N. Y.		"
Newark, N. J. to N. Y.	(1st prize among 69)	1878.
Tamaqua, Pa. to N. Y.	(1st " " 40)	"
Sunbury, Pa. to N. Y.	(1st " " 28)	"

This bird afterward won first prize from Altoona, Pa., 235 miles, and third prize from Steubenville, O., 355 miles.

In a sale of Homing Pigeons in Brussels in 1877, No. 4 on the catalogue sold for 170 francs.

It had flown from—

Valencienne,	50 miles.	Several prizes.
Arras,	100 "	" "
Orleans,	280 "	A prize.
Chateauroux,	325 "	" "
Langon,	600 "	(in 1876) 6th prize among 2000.
Lectoure,	600 "	201st prize among 2468.

Such is the wonderful travelling these birds perform.

In closing, let me say, that to any one of you, whether lady, gentleman, or child, in search of a hobby, I can heartily recommend the Pigeon Fancy. You may keep pigeons merely as delightful pets, breed them for prize points, or fly them as tumblers or racers.

ANNUAL MEETING, MONDAY, MAY 19, 1884.

THE annual meeting this evening at 7.30 o'clock: The PRESIDENT in the chair. Records of the last annual meeting were read and approved.

The reports of the Secretary, Treasurer, Auditor, Librarian and the Curators and Committees were read and duly accepted, and ordered to be placed upon file.

The committee on nominations reported the following list of officers, which was duly elected.

PRESIDENT:

HENRY WHEATLAND.

VICE-PRESIDENTS:

ABNER C. GOODELL, JR.
FREDERICK W. PUTNAM.
DANIEL B. HAGAR.
ROBERT S. RANTOUL.

SECRETARY:

GEORGE M. WHIPPLE.

TREASURER:

GEORGE D. PHIPPEN.

AUDITOR:

RICHARD C. MANNING.

LIBRARIAN:

WILLIAM P. UPHAM.

CURATORS:

History—HENRY F. WATERS.
Manuscripts—WILLIAM P. UPHAM.
Archæology—FREDERICK W. PUTNAM.
Numismatics—MATTHEW A. STICKNEY.
Geology—B. F. MCDANIEL.
Botany—GEORGE D. PHIPPEN.
Zoölogy—EDWARD S. MORSE.
Horticulture—JOHN E. PEABODY.
Music—JOSHUA PHIPPEN, JR.
Painting & Sculpture—T. F. HUNT.
Technology—EDWIN C. BOLLES.

COMMITTEES:

Finance:

The PRESIDENT, *Chairman ex off.*
HENRY M. BROOKS. GEO. R. EMMERTON. DAVID PINGREE.
The TREASURER, *ex off.*

Library:

CHARLES W. PALFRAY. HENRY F. KING. WILLIAM NEILSON.
WILLIAM D. NORTHEND. THEODORE M. OSBORNE.
The LIBRARIAN, *ex off.*

Publication:

EDWARD S. ATWOOD. ABNER C. GOODELL, JR. EDWIN C. BOLLES.
B. F. MCDANIEL. H. F. WATERS. JAMES A. EMMERTON. T. F. HUNT.

Lecture:

ROBERT S. RANTOUL. FREDERICK W. PUTNAM. AMOS H. JOHNSON.
FIELDER ISRAEL. ARTHUR L. HUNTINGTON.

Field Meeting:

The SECRETARY, *Chairman ex off.*

GEORGE A. PERKINS, Salem.
GEORGE COGSWELL, Bradford.
FRANCIS H. APPLETON, Peabody.
NATHANIEL A. HORTON, Salem.
EDWARD S. MORSE, Salem.
GEORGE D. PHIPPEN, Salem.
FRANK R. KIMBALL, Salem.
EBEN N. WALTON, Salem.
WINFIELD S. NEVINS, Salem.
JOHN H. SEARS, Salem.

THE RETROSPECT OF THE YEAR

compiled from the several reports read at the meeting, and the remarks of several members in relation thereto, presents the work of the Institute in its various departments since the last annual meeting.

MEMBERS.—Changes occur in the list of our associates by the addition of new names and the withdrawal of some by resignation, removal from the county or vicinity, or by death.

We have received information of the death, during the year, of twenty-four persons, who have been resident members.

GARDINER LEONARD CHANDLER, son of Gardiner L. and Lucretia C. (Green) Chandler, born in Boston, 9 April, 1806; artist; died in Salem, 27 May, 1883. Admitted a member 4 May, 1859.

CHARLES TIMOTHY BROOKS, son of Timothy and Mary (Mason) Brooks; born in Salem June 20, 1813; graduated at Harvard College in 1832, Harvard Theological

School in 1835; pastor of the Unitarian Church at Newport, R. I., from 1838 to 1871; died at Newport, 12 June, 1883. Admitted a member 12 Oct., 1859.

Ernest Bruno de Gersdorff, son of Ernest von Gersdorff, a judge of the court of Saxe Weimar; born in Elsenach, Germany, 18 July, 1820; graduated in medicine at Leipsic, 1846, and immediately came to this country, residing at Bethlehem, Penn.; then Andover; in 1849, Salem; in 1865, he removed to Boston; a physician; died at Pleasantville, N. Y., 28 June, 1883. Admitted a member 4 May, 1853.

Charles Cotesworth Beaman, son of Ephraim and Rebecca (Greenleaf) Beaman; born in Boston, 12 Aug., 1799; in early life engaged in business pursuits; then entered Andover Theological Seminary, and graduated in 1837; pastor of the Howard Street Church in Salem from 1857–1864, having previously occupied other pulpits; died in Boston, 4 July, 1883. Admitted a member 28 Jan'y, 1858.

Horace Brown, son of Haydn and Harriet (Emery) Brown; born at West Newbury, 31 Aug., 1851; graduated at Harvard College, 1872, the Harvard Law School in 1874; lawyer in Salem; died at West Newbury, 5 July, 1883. Admitted a member 5 April, 1875.

Samuel H. Nichols, son of Samuel H. and Sarah (Burdett) Nichols; born at Wakefield, N. H., 31 Jan'y, 1830; clerk; died in Salem, 9 July, 1883. Admitted a member 22 July, 1868.

John M. Ives, son of William and Mary (Bradshaw) Ives; born in Salem, 8 July, 1799. In early life he was in the book business, and at the same time kept a circulating library; afterwards interested in horticultural pursuits; died in Salem, 29 July, 1883. An original member.

STEPHEN BRADSHAW IVES, a brother of the preceding; born in Salem, 12 April, 1801; known for many years as a bookbinder and bookseller under the firm of W. & S. B. Ives; established the Salem Observer in 1823; died 31 July, 1883. Admitted a member 15 Feb., 1852.

WILLIAM SEWALL CLEVELAND, son of William and Mary (Hiller) Cleveland; born in Lancaster, 28 Feb., 1810; bookkeeper, secretary of the Commercial Insurance Company, treasurer of the Salem Turnpike and Chelsea Bridge Corporation, etc.; was for a long time a clerk with Charles S. Nichols & Co.; died in Salem, 3 Aug., 1883. An original member.

WILLIAM HUNT, son of William and Mary (Dean) Hunt; born in Salem, 25 April, 1804; a merchant, and with the late Robert Brookhouse was largely engaged in the west coast of Africa trade; died at Salem, 3 Aug., 1883. Admitted a member 25 Jan'y, 1854.

THOMAS S. JEWETT, son of Thomas and Lucy (Pinder) Jewett; born in Ipswich, 18 Jan'y, 1812; came to Salem when a boy and learned the carpenter's trade; followed this trade for many years; the past twenty-three years one of the assessors of Salem; died 13 Aug., 1883. Admitted a member 28 Jan'y, 1856.

WILLIAM LEAVITT, son of Joshua and Eunice (Richardson) Leavitt; born in Hingham, 15 April, 1801; came to Salem with his parents in 1801; in early life a clerk or salesman in a hardware store, afterwards a teacher in the grammar schools of Salem; many years an instructor in navigation and bookkeeping; interested in the local history of Salem and has compiled several communications for the Historical Collections of the Essex Institute; died at Salem, 3 Sept., 1883. Admitted a member 25 Nov., 1863.

James C. Stimpson, son of Thaddeus and Hannah (Cook) Stimpson; born at Salem, 9 July, 1799; one of the oldest tanners in Salem, and was for many years prominent in the leather business; for several years a member of the City Government, either in the Council or Board of Aldermen, and also for many years a director of the First National Bank. Died 11 Sept., 1883. Admitted a member 28 July, 1864.

Enoch K. Noyes, son of Enoch and Sarah Noyes; born at West Newbury, 11 Nov., 1820; a trader in Salem; died 11 Sept., 1883. Admitted a member 26 Aug., 1857.

Joseph Shatswell, son of Moses and Sarah (Lord) Shatswell; born in Ipswich, 2 Sept., 1801; merchant in Salem; for many years engaged in the West India trade; died 2 Oct., 1883. Admitted a member 20 Dec., 1854.

Peter Silver, son of James and Susanna (Howard) Silver; born in Salem, 2 Nov., 1811; in early life a master mariner, afterwards a retired merchant; died in Salem, 6 Oct., 1883. Admitted a member 6 July, 1864.

Benjamin Osgood Peirce, son of Benjamin and Rebecca (Orne) Peirce; born in Beverly, 26 Sept., 1812; and died there 12 Nov., 1883; graduated at Colby University, 1835; a teacher in several colleges and academies; since 1849 engaged in business pursuits. Admitted a member 19 July, 1880.

Joseph W. Chamberlain, son of John and Mary (Silver) Chamberlain; born in Salem, 25 Nov., 1830; druggist in Salem; died 10 Dec., 1883. Admitted a member 21 Sept., 1859.

Henry W. Perkins, son of Henry W. and Dolly (Webb) Perkins; born in Salem, 1 March, 1832; cashier

of the Mount Vernon National Bank, Boston; died in Salem, 19 Jan., 1884. Admitted a member 16 Dec., 1873.

William C. C. Moulton, son of Hiram and Mary (Batchelder) Moulton; born in Newport, Vt., 14 Oct., 1839; a trader in Salem; died 17 Jan'y, 1884. Admitted a member 14 July, 1864.

Stephen Bradshaw Ives, son of Stephen Bradshaw and Mary (Perkins) Ives; born in Salem, 8 March, 1827; graduated at Harvard College in 1848; admitted to Essex Bar in 1851. He did not hold many official positions, but was a celebrated and well-known advocate in the courts of the state; died at Salem, 8 Feb., 1884. Admitted a member 4 Jan'y, 1854.

James Moore Caller, son of John and Mary (Southwick) Caller; born in Pleasant Valley, N. Y., 11 Jan'y, 1813; came to South Danvers at an early age; for many years was largely engaged in the leather business as a tanner and currier; died in Salem, 13 Feb., 1884. Admitted a member 30 March, 1859.

John Archer, son of Jonathan and Rachel (Woodman) Archer; born in Salem, 4 July, 1796; in early life went to sea, and was privateering in the war of 1812–15; after the peace had a ship chandlery store on Derby street; for many years retired from active business; died 5 Mar., 1884. Admitted a member 26 May, 1858.

Otis Phillips Lord, son of Nathaniel and Eunice (Kimball) Lord; born in Ipswich, 11 July, 1812; graduated at Amherst College, 1832; admitted to the Essex Bar, Dec., 1835; practised in Ipswich until 1844, when he removed to Salem where he has since resided; Associate Justice of the Superior Court from 1859 to 1875, and Associate Justice of the Supreme Court from 1875

to Dec., 1882, when he resigned in consequence of failing health; died 13 March, 1884. Admitted a member 5 Oct., 1874.

Field Meetings. Five meetings have been held as follows:

First, on Tuesday, June 12, 1883, at "Oak Dell," South Georgetown, situated in a very delightful part of the county. Delegations from Georgetown, Groveland, Boxford, Topsfield and West Newbury joined those from Salem and its vicinity. After a ramble in the forenoon, and the lunch, the meeting was called to order, the president in the chair. Mrs. C. M. S. Horner, of Georgetown, spoke of the "Flora," Rev. Messrs. McDaniel, of Salem, and Alcott, of Boxford, on "Mineralogy and Geology," Messrs. Sidney Perley, of Boxford, and Henry M. Nelson, of Georgetown, on "Historical Matters of Local Interest;" there were also remarks from Messrs. M. W. Bartlett, of West Newbury, B. F. Stevens, of Boxford, and others.

Second, on Friday, June 29, 1883, at Dodge's Mill in Rowley, owned by Mr. Ignatius Dodge. The speakers at the afternoon session held in the old mill, where comfortable seats were improvised, were Messrs. John H. Sears, F. W. Putnam, John Robinson, Alfred Osgood and N. A. Horton. The remarks were mainly on archæological subjects, especially those of Messrs. Putnam, Robinson and Osgood.

Third, on Thursday, July 26, 1883, at Linebrook Parish, a rural country village in the western part of Ipswich. The afternoon session was held in the church. Mr. John H. Sears gave an account of the "Flora," Messrs. M. V. B. Perley and Sidney Perley spoke on "Historical Mat-

ters;" there were also remarks from Rev. B. F. McDaniel, Messrs. J. J. H. Gregory, A. C. Perkins, N. A. Horton, and others.

Fourth, on Wednesday, Aug. 15, 1883, at Balch's Grove, Groveland, by invitation of the Groveland Flower Mission. At the afternoon session, Miss Harriet E. Paine spoke on "The Plants of the Vicinity," Dr. George B. Loring on "Forestry;" there were also remarks from N. A. Horton and Dr. G. Cogswell.

Fifth, on Wednesday, Sept. 19, 1883, at West Peabody, by invitation of the Farmers' Club of that place. The forenoon was spent in visiting the farms of Messrs. Henry Saltonstall, and F. H. Appleton, and other places of interest. At the afternoon session, the speakers were Messrs. J. H. Sears, George Dixon, W. P. Upham, J. H. Ingraham, Willard Spaulding, James P. King and J. S. Kingsley.

MEETINGS.—Regular meetings occur on the first and third Monday evenings of each month. Special and adjourned meetings occasionally. At these meetings papers have been presented by the following persons and referred to the publication committee:

Edward A. Silsbee, on "Criticism of Poetry."

William G. Barton, on "Pigeons and the Pigeon Fancy.[1]"

Rev. B. F. McDaniel, on "The Literature and History of Bells."

J. Ritchie, jr., and *Charles Toppan*, on "A New Process of Bleaching."

F. L. Capen, on "Catastrophic Planetary Tidal Action of the Globe."

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[1] Bulletin, Essex Inst., Vol. XVI, p. 59.

Samuel Garman, on "The North American Reptiles and Batrachians, a list of the species occurring north of the Isthmus of Tehuantepec, with references.[2]"

Samuel Garman, on "An Extraordinary Shark (*Chlamydoselachus anguineus*)."[3]

Samuel Garman, on "A Species of Heptranchias supposed to be New."[4]

John H. Sears, on "Weeds of Essex County."[5]

F. W. Putnam, on "The First Notice of the Pine Grove or the Forest River Shellheap."[6]

Herbert B. Adams, on "The Great Pastures of Salem."[7]

J. A. Emmerton, on "Dr. Bentley's East Parish Deaths; some Notes and Corrections."[8]

Wellington Pool, "Inscriptions from Gravestones in the Old Burying Ground in Wenham."[9]

Leverett Saltonstall, "Memoir of Oliver Carlton."[10]

John T. Moulton, "Inscriptions from the Old Burying Ground in Lynn."[11]

Memorial of C. T. Brooks: "Birth and Boyhood," by E. B. Willson[12]; "His Life at Newport," by Charles W. Wendte[13]; "Letter from W. P. Andrews[14];" Remarks of R. S. Rantoul.[15]

Luke Brooks, "Genealogical Notes Respecting Henry Brooks and Some of his Descendants."[16]

Edward S. Atwood, "Memoir of John Bertram."[17]

Lectures.—A course of seven lectures, under the di-

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[2] Bulletin, Essex Inst., Vol. XVI, p. 3. [3] Bulletin, Essex Inst., Vol. XVI, p. 47. [4] Bulletin, Essex Inst., Vol. XVI, p. 56. [5] Bulletin, Essex Inst., Vol. XV, p. 93. [6] Bulletin, Essex Inst., Vol. XV, p. 85. [7] Hist. Coll., Essex Inst., Vol. XX, p. 161. [8] Hist. Coll., Essex Inst., Vol. XX, p. 209. [9] Hist. Coll., Essex Inst., Vol. XX, pp. 232 and 297. [10] Hist. Coll., Essex Inst., Vol. XX, p. 241. [11] Hist. Coll., Essex Inst., Vol. XX, p. 273. [12] Hist. Coll., Essex Inst., Vol. XXI, p. 1. [13] Hist. Coll., Essex Inst., Vol. XXI, p. 13. [14] Bulletin, Essex Inst., Vol. XV, p. 81. [15] Bulletin, Essex Inst., Vol. XV, p. 78. [16] Hist. Coll., Essex Inst., Vol. XXI, p. 24. [17] Hist. Coll., Essex Inst., Vol. XXI, p. 81.

rection of the lecture committee, has been delivered as follows: *First*, Alban Andren, of Beverly, "Sweden by a Swede," Wednesday, Nov. 28, 1883. *Second*, Ephraim Emerton, "Martin Luther," Wednesday, Dec. 19, 1883. *Third*, Arthur M. Knapp, "Greek Art," Wednesday, Jan'y 9, 1884. *Fourth*, George M. Towle, "Carlyle," Wednesday, Jan'y 30, 1884. *Fifth*, George B. Loring, "Nathaniel Hawthorne," Wednesday, Feb. 6, 1884. *Sixth*, George M. Towle, "Charles Dickens," Wednesday, Feb. 13, 1884. *Seventh*, Edward S. Morse, "First Impressions of China," Wednesday, March 5, 1884.

In addition to the above, the following lectures have been delivered in the rooms of the Institute.

George H. Hosmer, "Martin Luther," illustrated, Saturday, Nov. 10, 1883.

Matthew Arnold, Friday, Nov. 30, 1883, "Science and Literature."

Raymond Lee Newcomb, Tuesday, Dec. 4, 1883, "The Story of the Jeannette."

John G. Wood, "Whales," Monday, Dec. 10, 1883.

J. C. Welwood, "On the Rhine" (illustrated), Thursday, Jan'y 10, 1884.

John G. Wood, a course of four afternoon lectures: "Ants of the Temperate Zone," Friday, Feb. 15, 1884; "Ants of the Tropic Zone," Tuesday, Feb. 19; "Pond and Stream," Thursday, Feb. 21; "The Horse," Tuesday, Feb. 26.

Alban Andren, "An Evening in Sweden," Tuesday, March 18, 1884.

Morton Prince, "On the Anatomy and Physiology of the Vocal Organs," Monday, April 7, 1884.

PUBLICATIONS have been issued as heretofore. The exchange list, with few exceptions, continues the same as last year.

Library.—The additions to the Library for the year (May, 1883 to May, 1884) have been as follows:

By Donation.

Folios,	11
Quartos,	68
Octavos,	827
Duodecimos,	519
Sexdecimos,	98
Octodecimos,	25
Total of bound volumes,	1,548
Pamphlets and serials,	6,407
Total of donations,	7,955

By Exchange.

Folios,	11
Quartos,	68
Octavos,	827
Duodecimos,	519
Total of bound volumes,	526
Pamphlets and serials,	2,492
Total of exchanges,	3,018
Total of donations,	7,955
Total of exchanges,	3,018
Total of additions,	10,973

Of the total number of pamphlets and serials, 2,722 were pamphlets, and 6,177 were serials.

The donations to the Library for the year have been received from one hundred and seventy-eight individuals and fifty departments of the General and State Governments and Societies. The exchanges from three individuals, and from one hundred and sixty-three societies and incorporate institutions of which ninety-six are foreign; also from editors and publishers.

The annual examination of the Library has been made. Of the thirteen volumes that were missing last year, ten

have been returned; seven others are now missing from their places.

Donations or exchanges have been received from the following:

	Vols	Pam.
Adelaide, Royal Society of South Australia, ...		2
Agassiz, Alexander, Cambridge, ...		1
Allen, Nathaniel T., West Newton, ...		1
Almy, James F., ...	26	22
Almy, S. H., ...	1	4
Alnwick, Eng., Berwickshire Naturalists' Club, . .		1
American Association for the Advancement of Science, .	2	
American Library Association, ...		1
American Ornithologists' Union, ...		1
Ames, George L., ...		18
Ames, Sons of Oakes, ...	2	
Amherst College Library, ...	1	1
Amiens, Société Linnéenne du Nord de la France, .	1	13
Anagnos, M., So. Boston, ...		1
Andover, Theological Seminary Library, . . .		1
Andrews, Charles H., ... -		2
Andrews, Mrs. James H., ...		1
Andrews, William P., ...		50
Appleton, F. H., Peabody, ...		1
Archæological Institute of America, ...		1
Auckland, N. Z., Auckland Institute, Newspapers, Maps,	31	24
Augsburg, Naturhistorischer Verein, ...		1
Baltimore, Maryland Historical Society, . . .	2	
Baltimore, Md., Johns Hopkins University, ...		15
Baltimore, Md., Peabody Institute, ...		1
Bancroft, Rev. C. F. P., Andover, ...		1
Barnes, George William, San Diego, Cal., . . .		1
Barton, Edmund M., Worcester, ...	1	
Bassett, Samuel, Chelsea, ...	1	
Batavia, Natuurkundige Vereeniging in Nederlandsch India, ...	1	
Belfast, Naturalists' Field Club, ...		2
Bell, Charles H., Exeter, N. H., ...	1	
Bergen, Bergens Museum, ...	1	
Berlin, Gesellschaft Naturforschender Freunde, . .		1
Berlin, Verein zur Beförderung des Gartenbaues, . .		12
Bern, Naturforschende Gesellschaft, ...		1

	Vols.	Pam.
Bolles, Rev. E. C., D.D.,	2	138
Bologna, Accademia delle Scienze,		1
Bonn, Naturhistorischer Verein,	2	
Bordeaux, Académie des Sciences, Belles-Lettres et Arts,	3	4
Boston, American Academy of Arts and Sciences,	1	1
Boston, Appalachian Mountain Club,		3
Boston Art Club,		1
Boston, Board of Health,		12
Boston, Bostonian Society,		1
Boston, City of,	4	
Boston, City Hospital,	1	
Boston, Massachusetts General Hospital,		1
Boston, Massachusetts Historical Society,	1	
Boston, Massachusetts Horticultural Society,		1
Boston, Massachusetts Medical Society,		1
Boston, National Association of Wool Manufacturers,		3
Boston, New England Historic Genealogical Society,	1	5
Boston, Overseers of the Poor,	1	
Boston Public Library,		4
Boston Society of Natural History,		21
Boston, State Board of Health, Lunacy and Charity,	2	
Boston, State Library of Massachusetts,	18	1
Boston Zoölogical Society,		3
Boutwell, F. M., Groton,		1
Bradlee, Rev. C. D., Boston,		1
Braunschweig, Archiv für Anthropologie,	1	1
Bremen, Naturwissenschaftlicher Verein,		1
Bristol, Eng., Naturalists' Society,		2
Brooklyn, N. Y., Brooklyn Library,		2
Brooklyn, N. Y., Long Island Historical Society,		1
Brooks, Mrs. Henry M., . . . Newspapers,		
Brown, Henry A.,	145	573
Browne, A. G., Jr., New York, N. Y.,		3
Brünn, Naturforschender Verein,	1	3
Brunswick, Me., Bowdoin College Library,		9
Bruxelles, Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique,	9	
Bruxelles, Société Belge de Microscopie,	1	10
Bruxelles, Société Entomologique de Belgique,	2	
Bruxelles, Société Royale de Malacologique,	1	12
Buenos Aires, Sociedad Cientifica Argentina,	1	11
Buffalo, N. Y., American Society of Microscopists,		1
Buffalo, N. Y., Historical Society,		2

		Vols.	Pam.
Buffalo, N. Y., Society of Natural Sciences,			1
Caen, Académie des Sciences, Arts et Belles-Lettres,		1	
Calcutta, Geological Survey of India,		2	16
Cambridge, Harvard University Library,			3
Cambridge, Museum of Comparative Zoölogy,			11
Cambridge, Nuttall Ornithological Club,			3
Carpenter, Rev. C. C., Mt. Vernon, N. H.,			1
Cassel, Verein für Naturkunde,			1
Chamberlain, James,	Maps,	26	58
Chauncy, Elihu, New York, N. Y.,		1	
Chicago, Ill., Historical Society,		2	1
Chicago, Ill., Inter Ocean Publishing Company,			1
Chicago, Ill., Public Library,			1
Chilovi, D., Firenze, Italy,			1
Christiania, K. Norske Universitet,		1	4
Christiania, Norské Gradmaalingskommission,			1
Christiania, Videnskabs-Selskabet,		1	
Cincinnati, O., Historical and Philosophical Society,			1
Cincinnati, O., Mechanics' Institute,			1
Cincinnati, O., Society of Natural History,			4
Clarke, George K., Needham,			1
Cleveland, O., Western Reserve Historical Society,			3
Cleveland, Mrs. William S.,		1	85
Coffin, C. C., Boston,			1
Cogswell, W. F., Beverly, N. J.,			3
Cole, Mrs. N. D.,	Newspapers,		99
Conant, F. O., Portland, Me., Chart of the Conant Family,			
Conant, W. P., Washington, D. C.,		2	1
Copenhague, Société R. des Antiquaires du Nord,			7
Crowell, Rev. E. P., D.D., Amherst,		1	1
Cutter, Abram E., Charlestown,			1
Danzig, Naturforschende Gesellschaft,		1	
Darling, C. W., Utica, N. Y.,			2
Darmstadt, Verein für Erdkunde,		1	
Davis, Joseph, Lynn,		1	
Delisle, M. Leopold, Paris,			1
Dement, Henry D., Springfield, Ill.,		1	
Dodge, James H., Boston,		1	
Doolittle, Miss E., Troy, N. Y.,			1
Dresden, Naturwissenschaftliche Gesellschaft, Isis,			2
Dresden, Verein für Erdkunde,			1
Dublin, Royal Irish Academy,			7
Dublin, Royal Society,		2	5

		Vols.	Pam.
Du Rieu, Dr. W. N., Leide,			1
Eagleston, John H.,		1	
Edinburgh, Royal Society,			1
Eddy, R. H., Boston,			1
Emden, Naturforschende Gesellschaft,			1
Emerton, James,			33
Emmerton, James A.,	Newspapers,	1	45
Epping Forest and County of Essex Naturalists' Field Club,			1
Erlangen, Physikalisch-medicinische Societät,			1
Exeter, N. H., Phillips Academy,		1	2
Falmouth, Eng., Royal Cornwall Polytechnic Society,		1	
Farley, Mrs. M. C.,		58	101
Fewkes, J. Walter, Cambridge,			1
Flanders, Rev. G. T., D.D., New Bedford,			1
Fogg, Miss Ellen M.,		12	1
Foote & Horton,	Newspapers,		
Frankfurt, a. m., Senckenbergische Naturforschende Gesellschaft,			5
Freiburg, Naturforschende Gesellschaft,		1	
Gates, Beman, Marietta, O.,			1
Genève, Société de Physique et d'Histoire Naturelle,		1	
Giessen, Oberhessische Gesellschaft für Natur u. Heilkunde,		1	
Gillis, James A.,		1	59
Glasgow, Natural History Society,			1
Goodell, A. C., Jr.,			9
Goodwin, D., Jr., Chicago, Ill.,			1
Göttingen, K. Gesellschaft der Wissenschaften,		1	
Gould, John H., Topsfield,	Newspapers,		25
Green, Samuel A., Boston,		127	426
Gregory, J. J. H., Marblehead,	Newspapers,	11	12
Güstrow, Verein der Freunde der Naturgeschichte in Mecklenburg,		1	1
Hale, Josiah L., Brookline,		3	1
Halle, a. S., Naturwissenschaftlicher Verein für Sachsen u. Thüringen,			11
Hamilton, R. I., Narragansett Historical Publishing Company,			4
Hannover, Gesellschaft für Mikroskopie,			1
Hannover, Naturhistorische Gesellschaft,			1
Hapgood, H. L., Athol,			4
Harlem, Société Hollandaise des Sciences,			4
Hart, Charles Henry, Philadelphia, Pa.,			2

	Vols.	Pam.
Hartford, Conn., Trinity College, ...		1
Hassam, John T., Boston, ...		1
Hazen, Rev. Henry A., Boston, ...	1	
Herford, Rev. Brooke, Boston, ...	1	
Hewitt, Abram S., New York, N. Y., for the late Peter Cooper, ...	1	
Hill, B. D., ... Newspapers,		17
Hill, William M., ...		1
Hitchcock, Edward, Amherst, ...		3
Hobart Town, Government of Tasmania, ...	1	
Hobart Town, Royal Society of Tasmania, . . .		1
Hodges, Mrs. Elizabeth, Estate of the late, . . .	86	3
Holmes, J. C., Detroit, Mich., ...	1	2
Honeycomb, Mrs. T. P., ...		21
Hunt, T. F., ...	31	223
Illinois Department of Agriculture, ...	1	7
Iowa City, Ia., State Historical Society, . . .	60	5
Israel, Rev. Fielder, ... Newspapers,	9	51
Ithaca, N. Y., Cornell University, ...		1
James, Joseph F., Cincinnati, O., ...		1
James, U. P., Cincinnati, O., ...		2
Johnson, Emery S., ...		1
Joy, Walter H., ...		1
Kimball, Mrs. James, ...	1	
Kingsley, J. S., Malden, ...		7
Kjöbenhavn, Botanisk Förening, ...		3
Kjöbenhavn, K. D. Videnskabernes Selskab, . . .		3
Königsberg, Physikalisch-ökonomische Gesellschaft, .		2
Langworthy, Rev. I. P., Boston, ...		1
Lansing, Mich., State Library, ...	13	14
Lausanne, Société Vaudoise, ...		1
Lawrence, Public Library Trustees, ...	1	
Lee, Francis H., ...		191
Lee, William, Boston, ...	2	
Le Mans, Société d'Agriculture, Sciences et Arts de la Sarthe, ...		2
Lisboa, Academia Real das Sciencias, ...		10
Liverpool, Eng., Literary and Philosophical Society, .	3	
London, Eng., Royal Society, ...		6
Loring, George B., ...	1	
Lowell, Old Residents' Historical Association, . .		1
Lyon, Société d'Agriculture, ...	1	
Lyon, Société Linnéenne, ...	1	

	Vols.	Pam.
Mack, Miss Esther C., ...	6	199
Madison, Wis., State Historical Society, . . .	63	2
Madison, Wis., Superintendent of Public Property, .	2	
Madrid, Sociedad Española de Historia Natural, . .		3
Mannheim, Verein für Naturkunde, ...		1
Manning, F. H., Boston, ...		1
Manning, Robert, ...		846
Marburg, Gesellschaft zur Beförderung der Gesammten Naturwissenschaften, ...		2
McDaniel, Rev. B. F., ... Newspapers,		50
McDanolds, James S., Trenton, N. J., ...	3	
Meek, Henry M., ...	1	
Merrill, George S., Lawrence, ...		1
Merrill, W. Jr., West Newbury, ...		1
Metz, Société d'Histoire Naturelle, ...		1
Mexico, Museo Nacional, ...		3
Miller, Lewis F., ...		1
Montreal, Natural History Society, ...		2
Moulton, John T., Lynn, ...		1
München, K. B. Akademie der Wissenschaften, . .		10
Münster, Provinzial Verein für Wissenschaft u. Kunst, .		1
Napoli, R. Accademia delle Scienze Fisiche e Matematiche, ...	6	46
Neuchâtel, Société des Sciences Naturelles, . . .	1	
Nevins, W. S., ... Newspapers,		13
Newark, New Jersey Historical Society, . . .	1	2
New Haven, Conn., Yale College Library, . . .		4
Newlands, John A. R., London, Eng., ...	1	
Newport, R. I., Natural History Society, . . .		1
New York Academy of Sciences, ...		7
New York, American Geographical Society, . . .		4
New York, American Museum of Natural History, .		2
New York, Genealogical and Biographical Society, .		5
New York, Historical Publication Company, . .		1
New York, Historical Society, ...	2	
New York, Mercantile Library Association, . . .		4
Northampton, Smith College, ...		1
Norwegian North Atlantic Expedition, ...		1
Nourse, Miss Dorcas C., ... Newspapers,		22
Odell, Charles, ...		28
Oliver, Henry K., ...		24
Orne, A. C., Marblehead, ...	1	
Osgood, Alfred, Newburyport, ...	1	

	Vols.	Pam.
Osgood, John C.,		2
Ottawa, Geological and Natural History Survey of Canada, ... Maps,	1	
Palfray, Charles W.,	3	66
Paris, Institution Ethnographique,	1	
Paris, Société d'Acclimation,		11
Paris, Société d'Anthropologie,		6
Paris, Société des Etudes Historiques,	1	1
Peabody Institute,		1
Peabody, John P.,	2	
Peet, Rev. S. D., Clinton, Wis.,		4
Peirce, Henry B., Boston,	11	
Perkins, A. C., Exeter, N. H.,		1
Perkins, George A.,		24
Perkins, J. McC., Boston,		2
Perley, Jonathan,	14	1
Perry, Rev. William Stevens, Davenport, Ia.,		1
Philadelphia, American Philosophical Society,		2
Philadelphia, Library Company,		2
Philadelphia, Historical Society of Pennsylvania,	8	161
Philadelphia, Mercantile Library Company,		3
Philadelphia, Numismatic and Antiquarian Society,		1
Phillips, Henry, Jr., Philadelphia,	1	1
Plumer, Miss Mary N.,		5
Pollard, Samuel S., Boston,	136	680
Pool, Wellington, Wenham,		2
Poole, W. F., Chicago,		1
Porter, Rev. Aaron, Mendon,		1
Pratt, Henry J.,		2
Preble, George H., Brookline,		2
Preston, Charles P., Danvers,		1
Providence, Rhode Island Historical Society,	1	2
Providence, R. I., Public Library,		16
Pumpelly, Raphael, Newport, R. I., . . . Maps,		
Putnam, Rev. A. P., Brooklyn, N. Y.,		1
Putnam, Mrs. Eben,		16
Putnam, Mrs. Esther O., Cambridge,		1
Putnam, F. W., Cambridge,		5
Quebec, Laval Université,		1
Quill, D. W.,		1
Ramsay, Alexander, London, Eng.,		1
Ranck, G. W., Lexington, Ky.,		1
Rantoul, R. S.,	9	37

	Vols.	Pam.
Regensburg, K. B. Botanische Gesellschaft, . .	1	
Regensburg, Zoologisch-mineralogischer Verein, .		1
Richardson, F. P., ...	2	4
Richmond, Virginia Historical Society, . . .	1	
Riga, Naturforschender Verein, ...		1
Rio de Janeiro, Museu Nacional, ...	2	1
Roberts, Mrs. J. K., ...	4	
Robinson, E. P., Saugus, . . . Newspapers,		
Robinson, John, ...		208
Robinson, Mrs. John, ...		113
Ropes, Rev. W. L., Andover, ...	1	
Russell, Mrs. Thomas B., ...		1
Salem Fraternity, ...	12	2
Salem, Peabody Academy of Science, Newspapers, Maps,	5	245
Saltonstall, Leverett, Boston, . Newspapers, Maps,	558	349
Sampson, Davenport & Co., Boston, ...	18	
San Francisco, California Academy of Sciences, . .		1
San Francisco, Cal., Mercantile Library Association, .		1
Secomb, Daniel F., Concord, N. H., ...	1	
S'Gravenhage, Nederlandsche Entomologische Vereenig-ing, ...		4
Shufeldt, R. W., New Orleans, La., ...		1
Sibley, Miss A. M., ...	2	
Silliman, B., New Haven, Conn., ...	3	
Sims, William, Topeka, Kan., ...	1	
Skinner, John B., ...	4	
Slocum, Charles E., Defiance, O., ...	1	
Smiley, C. W., Washington, D. C., ...	5	
Smith, George Plumer, Philadelphia, Pa., . . .	5	2
Smithmeyer, J. L., Washington, D. C., ...		1
Smucker, Isaac, Newark, O., ...		1
Soule & Bugbee, Boston, ...	8	23
Springfield, Mo., Drury College Library, . . .	105	69
Stettin, Entomologischer Verein, ...	1	
St. Gallen, St. Gallische Naturwissenschaftliche Gesell-schaft, ...	1	
Stickney, George A. D., ...		9
Stickney, M. A., ...	1	
St. John, New Brunswick Natural History Society, .		2
St. Louis, Mo., Public School Library, ...		1
Stockholm, Entomologiska Föreningen, ...		3
Stoddard, Mrs. Frances Mary, Roxbury, . . .	1	
Stone, Eben F., Washington, D. C., ...	16	132

	Vols.	Pam.
Stone, Rev. Edwin M., Providence, R. I., . . .		1
Stone, Miss Mary H., ...		126
Stone, Robert, ... Newspapers,		
Story, Miss E. A., ...	1	1
St. Paul, Minnesota Historical Society, . . .		1
St. Pétersbourg, Académie Impériale des Sciences, .		15
St. Pétersbourg, Jardin Impérial de Botanique, . .		2
St. Pétersbourg, Societas Entomologica Rossica, .	1	
Taunton, Eng., Somersetshire Archæological and Natural History Society, ...	1	
Terre Haute, Ind., Rose Polytechnic Institute, . .		1
Throndhjem, K. N. Videnskabers Selskabs, . . .		1
Tokio, University of, ...		1
Topeka, Kan., State Historical Society, Newspapers,		
Toronto, Canadian Institute, ...		20
Tuckerman, Mrs. J. F., ...	2	
Tuckerman, L. S., ... Maps,		512
Twyman, Joseph, Chicago, Ill., ...		11
Unknown, ...	4	8
Upsal, Société Royale des Antiquaires du Nord, . .		1
U. S. Bureau of Education, ...	1	9
U. S. Chief of Engineers, ...	1	
U. S. Chief Signal Officer, ...		6
U. S. Coast and Geodetic Survey, ...	2	
U. S. Department of Agriculture, ...	1	4
U. S. Department of the Interior, ...	65	
U. S. Department of State, ...	2	8
U. S. Fish Commission, ...	2	
U. S. Geological Survey, ...	3	1
U. S. Life Saving Service, ...	1	
U. S. National Museum, ...		34
U. S. Naval Observatory, ...	1	
U. S. Patent Office, ...	7	54
U. S. Treasury Department, , ...	1	
U. S. War Department, ...	4	
Ward, James W., Buffalo, N. Y., ...		1
Waring, Geo. E., Jr., Newport, R. I., ...		2
Washington, D. C., Anthropological Society, . .	1	
Washington, D. C., Smithsonian Institution, . .	7	
Waters, E. Stanley, ... Newspapers,		
Waters, J. Linton, ... Newspapers,	2	18
Waterston, Rev. R. C., Boston, ...	1	
Waterville, Me., Colby University Library, . . .		16

		Vols.	Pam.
Webber, Charles H.,			1
West, Mrs. George,	Newspapers,	6	13
Wheatland, Henry,			35
Wheatland, Miss Martha G.,			3
Wheatland, Philip D., Boston,			1
Wheildon, William W., Concord,			3
Whipple, G. M.,		29	16
Whitcher, Mary, Shaker Village, N. H.,			12
Whiteley, John, Shirley Village,		2	16
Whitney, Mrs. H. M., Lawrence,	Newspapers,		
Whitney, J. L., Concord,			3
Wien, K. K. Zoologisch-botanische Gesellschaft,		1	1
Wiesbaden, Nassauischer Verein für Naturkunde,			1
Wilder, Marshall P., Boston,		1	1
Wildes, Rev. George D., Riverdale, N. Y.,			1
Wilkes-Barré, Wyoming Historical and Geological Society,		127	40
Williamstown, Williams College,			2
Willson, Rev. E. B.,		12	78
Winnipeg, Manitoba Historical and Scientific Society,			6
Winsor, Justin, Cambridge,			32
Worcester, American Antiquarian Society,			2
Worcester, Free Institute,			1
Worcester, Society of Antiquity,			3
Worcester, Society of Natural History,			1
Würzburg, Physikalisch-medicinische Gesellschaft,		1	1
Zincken, C. F., Leipzig,			1

The following have been received from editors or publishers:—

American Journal of Science.
Bay State Monthly.
Cape Ann Bulletin.
Chicago Journal of Commerce.
Danvers Mirror.
Essex County Statesman.
European Mail.
Fireside Favorite.
Gardener's Monthly and Horticulturist.
Ipswich Chronicle.
La Bibliophilie.
Lawrence American.
Lynn Bee.
Manifesto.
Mansill's Signal.
Marblehead Messenger.
Medical Register.
Musical Herald.
Musical Record.
Musical Review.
Nation.
Naturalist's Leisure Hour and Monthly Bulletin.

Nature.
Newton Transcript.
Our Dumb Animals.
Peabody Press.
Quaritch's Catalogue.
Sailors' Magazine and Seamen's Friend.
Salem Evening News.
Salem Gazette.
Salem Observer.
Salem Register.
Stove and Hardware Reporter.
Turner's Public Spirit.
West Newbury Era.
Zoologischer Anzeiger.

THE ART EXHIBITION opened on Wednesday evening, May 23, 1883, the seventh under the auspices of the Institute. These exhibitions of Essex County work have an increasing interest for those who watch them carefully from year to year, as an indication of a growth of art feeling in the community, and of the development of talent whose beginnings we have seen, as well as of the appearance of new aspirants whose early endeavors are full of interest and sometimes of decided promise.

The electric light was put into the hall for the first time, and enabled the visitors in the evening to see the collection to much better advantage than heretofore. Some excellent photographs were made of a portion of the exhibit with this light.

There were on exhibition, from one hundred and forty-four contributors, four hundred and eight specimens in the various departments of art. The arrangement was very effective, and the hall attractive.

The following is the list of contributors :

Miss Delia Sheldon, Beverly.
" Ida Caller.
John and Henry Benson.
Mrs. Sara K. Hart.
Miss E. A. Welch, Georgetown.
Mr. Arthur W. Dow, Ipswich.
Miss Edith B. Pickering.
" Edith Rantoul.
Mr. David H. Barry, Marblehead.
Mr. Albert I. Whipple.
Mrs. A. P. Newhall, Lynn.
Miss C. B. Crossman, Swampscott.
Miss S. Ellen Pratt.
" L. L. A. Very.

Miss A. D. Crain.
Mr. E. D. Jones.
Miss S. E. Ober, Beverly.
" E. Philbrick.
" A. G. Endicott.
" Helen Philbrick.
Mr. Sydney P. Guild, Lynn.
Miss H. M. King.
" E. B. Gardner.
" I. S. Jackson.
Mrs. J. H. Langmaid.
" W. H. A. Putnam.
" K. T. Woods.
Mr. J. Mackintire.
Miss Vinnie Browne.
" B. P. Smith.
Mrs. J. C. Abbott.
Miss Carrie Goldthwaite.
" T. R. Nason.
Geo. W. Harvey, Gloucester.
Arthur L. Toppan.
Mrs. M. A. Bovie.
Miss S. S. Kimball.
" M. E. Standley.
J. Appleton Brown, Boston.
Frank M. Cone.
N. B. Cone.
Mr. Joseph Ropes.
Miss Mary L. King.
" M. M. Brooks.
Master Henry Whipple.
" Frank Frye.
" Harry Putnam.
" Richard Ives.
" John G. More.
" Beverly Rantoul.
Miss M. Dixie, Marblehead.
" B. Darling.
" Nellie Flint.
" E. E. Grush.
" M. A. Bigelow.
" Lizzie Brooks.
Mrs. Charles Sewall.
Miss Grace R. Sewall.
Mrs. Geo. Harrington.
Mr. E. C. Larrabee.
" F. B. Choate.
Mrs. M. W. C. Thayer.
Miss S. E. Brown.
" Ruth S. Mugford, W. Peabody.
Miss A. G. Pingree.
Mr. J. J. Redmond.
Mrs. George Upton.
" Helen F. Jacobs, Peabody.
Miss Edith B. Dalton.
" M. W. Nichols.
" K. Peirson.
" A. L. Peirson.
" A. F. Williams.
Mrs. W. A. Smith.
Miss M. L. Hill.
" Kate Dodge.
" Abby Streeter.
Mrs. G. L. Streeter.
Miss Kate Pond.
" Minnie Pond.
Mrs. F. W. Tuttle.
Miss Alice D. Perkins.
" E. W. Fiske.
" Lizzie R. Pickering.
" M. O. Barrett.
" Lucy B. Hood.
" Annie Symonds, Peabody.
Mr. F. Powers.
Miss Agnes L. Babcock.
" C. F. Chase.
" Maggie Bolles.
" H. L. Kimball.
Mrs. Chas. E. Symonds.
" Chas. N. Symonds.
Miss Mary Robinson.
" Beatrice E. Symonds.
Mrs. C. P. Sears, Danvers.
" Damon.
Miss Annie Agge.
" Mary E. Phippen.
" Alice S. Batchelder.

Miss A. M. Quinby.
" H. McMullen.
Mrs. J. H. Roberts.
" N. A. Frye.
Miss Caroline P. Lummus, Peabody.
Mrs. E. R. Bigelow.
Miss Myra Hall.
" C. A. Fabens.
Mrs. Jos. Symonds.
Frank W. Benson.
Annie W. Poole.
Miss M. M. Farley.
" A. M. Osborne.
" H. Frances Osborne.
" Miranda Swan.
" C. H. Sweetser.
" A. F. Perkins.
" L. C. Symonds.
Mrs. H. H. Davis.
Miss Lucy P. Robinson.
Mrs. J. Robinson.
Miss E. W. Chadwick,
" A. L. Chadwick.
" A. D. Varney.
" A. S. Tukey.
Mr. C. H. Lefavour.
Mrs. S. B. Ives, jr.
Miss Eva Farndale.
" Rose Farndale.
" Bessie Putnam.
Mrs. E. V. Emilio.
Miss Nellie B. Nowland.
" M. K. Stevens.
" A. B. Holden.
E. B. Stewart, Lynn.
Miss Louisa Lander.
" Alice Osborne.
" S. E. Smith.
Mrs. Mary W. Whitney, Lawrence.
Mrs. R. C. Manning.
Miss A. B. Hunt.
Mr. C. F. Whitney.

Horticultural.—The trustees of the Essex Agricultural Society, having accepted the invitation of the authorities and citizens of Salem to hold their annual Cattle Show and Fair at the "Willows" in Salem, on Tuesday and Wednesday, Sept. 25 and 26, 1883, the Institute deemed it advisable to suspend all operations in that direction and to cordially unite with the trustees of the Agricultural Society in making their undertaking a success.

An account of the exhibition will be found in the "Transactions" of that Society for the year 1883.

Museum. The specimens in natural history, including those in archæology, which have been given during the year, are on deposit with the Trustees of the Peabody Academy of Science, in accordance with previous arrangements. Those of an historical character or which possess an artistic interest have been placed in the rooms.

The following may be specified as contributors:

Edwin R. Ide.
Leverett S. Tuckerman.
Edward S. Morse.
Edward S. & Henry Huntington Nelson.
Charles W. Palfray.
George G. Putnam.
T. F. Hunt.
John C. Osgood.
Peabody Academy of Science.
William Reith.
Charles Odell.
Capt. Henry F. King.
Miss Dorcas C. Nourse.
Charles H. Webber.
Rev. Fielder Israel.
Rev. B. F. McDaniel.
Peter Coffee.
George M. Whipple.
Miss F. L. Prescott.
Miss C. A. Hurlburt.
Rev. George B. Jewett.
Mrs. John Robinson.
Ezekiel Goss.
Daniel Henderson.
Moses S. Prime.
B. D. Hill.
Philip D. Wheatland.
Eben N. Walton.
Tenn. Historical Society.
John Larcom.
William Chambers.
Henry A. Brown,
Miss Caroline L. Bayley.
Lemuel B. Hatch.
Frank T. Mooney.
J. Coward.
H. M. Batchelder.
John Davis.

Among the additions to the cabinets during the year, a very interesting historical relic has been received, the inkstand of Wordsworth. A brief account of the manner in which it came into our possession may not be devoid of interest. In August last a letter was received from Mrs. Sarah N. (Pope) Dixon, formerly of Salem, now a resident of Darlington, Eng., dated Aug. 14, 1883, giving an account of her recent visit to Ambleside, in the Lake district, and of a pleasant call at "Stock-Ghyll Force or Falls," the residence of Mr. J. Coward, "who exhibited an inkstand, being the one used by Wordsworth. He said that he had many offers for it, but he would not sell, but would give it to some society or museum. Immediately I spoke a word for the Essex Institute, and he gave his word that he would give it." Ambleside was the home of Wordsworth from 1813 till his death April 23, 1850; the locality teems with memorials of him; there is

scarcely a crag, a knoll, or a rill which he has not celebrated in verse. On Jan'y 25, 1884, a letter was received from Capt. W. T. Hill of the barque "Venice," dated Charleston, S. C., Jan'y 21, 1884, stating that he had, on board, the inkstand of Wordsworth that was put into his hands by Mr. J. Coward, with the request to deliver the same to the Essex Institute; he intended to visit this section on his arrival, but was obliged to return to Liverpool and accordingly sent it by mail. It was duly received in good condition.

The Institute is under deep obligations to Mrs. Dixon, the suggester, to Mr. Coward the donor, and to Capt. Hill the transporter, a worthy trio by whose combined efforts this interesting relic of a well-known and much admired poet of old England has found its way to Plummer Hall, where it will long remain an object of interest to all who delight to study the literature of our fatherland.

FINANCIAL.—The Treasurer's Report of the receipts and expenditures of the past year (condensed for printing).

RECEIPTS.

Balance of last year's account		$54 64
INCOME OF *General Account*		
Assessments of Members	$881 00	
Publications	575 36	
Lectures, Excursions, Hall, etc.	524 77	
Dividend	40 21	
Salem Athenæum, Proportion of Expense	204 26	
		$2228 60
Income of *Historical Fund*		44 00
" " *Nat. Hist. Soc. Fund*		36 00
" " *Davis Fund*		392 16
" " *Ditmore Fund*		180 40
" " *Manuscript Fund*		24 94
" " *Ladies' Fair Fund*		60 00
" " *Derby Fund*		28 72
" " *Howes Fund*		1430 00
" " *Story Fund*		563 00
Loan on Note of Corporation		400 00
		$5,442 46

EXPENDITURES.

PAID ON *General Account*		
Salaries	$1832 00	
Publications	1081 80	
Fuel and Gas	257 79	
Binding, Printing, Books and Stationery	401 81	
Repairs, Express, Postage, etc.	125 75	
Salem Athenæum, Rent and Labor	350 00	
		$4049 15
Paid on Historical Account		56 26
" " Nat. History "		56 25
" " Ditmore Fund Annuity		110 00
Interest on Manuscript Fund funded in Savings Bank		24 94
" " Derby Fund funded in Savings Bank		28 72
" " Davis Fund funded at Savings Bank		12 16
" " Story Fund, paid to Legatee		563 00
Paid Note $500 and interest		541 04
Balance on hand		94
		$5,442 46
The invested funds are now		$45,832 60

Examined and approved by the Auditor, May 19, 1884.

The Secretary in concluding his report, says:

The urgent need of room for the shelving and arrangement of donations to the Library and the Museum, forces itself upon the attention of the officers of the Institute daily. In some of the cases books are already piled three deep, and valuable gifts to the Museum are stored away in drawers and other places, practically valueless to visitors for the purposes of examination. During the past year the matter of increased accommodations has been once more agitated, and plans for an addition to the present building have been laid before some of the officers of the Salem Athenæum and of the Institute for their informal consideration. The lack of funds to carry out these improvements appears to be the only reason for delaying a movement in this direction. Thirty thousand dollars, it is believed, would give ample room to both the Athenæum and the Institute. Some relief must be devised and that speedily. The subject is again commended to the attention of the directors.

BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 16. SALEM: JULY TO DEC., 1884. NOS. 7–12.

FIELD DAY AT TOPSFIELD, WEDNESDAY, JUNE 18, 1884.

NOTWITHSTANDING the extreme heat and dusty roads, a party numbering about sixty left Salem in carriages at 9 A. M. for a day in Topsfield. After a pleasant drive through Peabody and Danvers, the party arrived at the country residence of Col. T. W. Peirce, by whose kind invitation three hours were agreeably spent in rambling over the estate and visiting the greenhouses, conservatories, gardens and other places and objects of interest. This farm for some one hundred and fifty years was known as the old "Estey Place," previous to the sale, Sept. 5, 1821, to Hon. Benjamin W. Crowninshield of Salem,[1] by Daniel Estey of Topsfield, who inherited the same, by will, from his father Aaron Estey. The heirs of Mr. Crowninshield, April 21, 1852, sold to Dwight Boyden of Waltham;[2] Mr. Boyden, Sept. 10, 1852, to Frederick Boyden;[3] Mr. F. Boyden, June 2, 1856, to William Hammond Foster of Boston;[4] Mr. Foster, Jan'y 6, 1857, to the present proprietor, Thomas W. Peirce,[5] who has added to the original

[1] See Essex Reg. Deeds, Lib. 227, fol. 246. [2] Reg. Deeds, 460–54.
[3] Reg. Deeds, 468–237. [4] Reg. Deeds, 532–244. [5] Reg. Deeds, 544–129.

purchase by the annexation of adjoining lands, so that it now contains between four and five hundred acres. It is only within six or eight years that Mr. Peirce has inaugurated and perfected many extensive improvements: substantial and well-built faced stone walls now run all over the estate; low lands have been drained in a thorough and systematic manner, and the whole farm has been brought to a high degree of productiveness. The barn which was built by Mr. Aaron Goldthwaite of Salem, as were most of the other buildings, is an immense structure, the upper portion of which is used for the storage of hay, while the lower floor has accommodations for horses and cattle; the livestock now kept numbers 130 cows (and heifers), 11 working cattle, 8 horses and 4 bulls — Holstein, Ayrshire and Jerseys are the breeds represented; in the rear of the barn is the blacksmith's shop, with a twenty-horse power engine, where the general repairing of the farm tools is done; also the poultry house 100 feet by 15 feet, and other buildings. The Newburyport turnpike runs through the estate; the farmhouse and farm-buildings are located on the southern side, while the mansion house and porter's lodge (a most picturesque little cottage) are across the way on the hillside rising to the north. On the top of the hill in the rear of the house is a fine tower containing a tank with a capacity of 13,000 gallons; at the foot of the hill to the west is a never-failing supply of pure spring water and a pumping station. From the top of the tower is a magnificent view of the surrounding country and towns. Mt. Wachuset in this state, and the waters of Massachusetts Bay from Nahant to Cape Ann, are *always* visible on clear days; and the White Mountains are said to be occasionally seen.

The noonday lunch was partaken of in the large barn, tables and other suitable accommodations being provided.

At 2 P. M. the party drove to the Town Hall in Topsfield, about a mile and a half distant, where the afternoon session was held; the original party having increased to more than thrice its number by accessions from Topsfield, Groveland, Boxford and other towns in the vicinity.

At 2.30 P. M. the meeting was called to order by President Henry Wheatland, who in an opening address said that the exercises of the afternoon were arranged in commemoration of the fiftieth anniversary of the meeting held in Topsfield, on Wednesday, April 16, 1834, to complete the organization of the Essex County Natural History Society, one of the parent societies of the Essex Institute, preliminary meetings having been held at Salem in the December previous. It was intended that this meeting should have been held in April, but owing to the backwardness of the season and the inclement weather it was decided that it should be postponed to a day in June, to be selected by the committee on field meetings. Papers, especially prepared for this occasion, which are appended, were read by Prof. E. S. Morse, Mr. John Robinson, Rev. B. F. McDaniel and Mr. S. P. Fowler.

After the presentation of the papers the following gentlemen were called upon:

Hon. JAMES J. H. GREGORY commenced his remarks by quoting the old saying, "If you require proof of their work look around you," and applied it to what the society has done. One thing, he said, the other speakers had not touched upon,—local Indian antiquities and relics.[6]

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[6] This subject was assigned to Vice President Putnam, who had prepared himself to speak upon it, but was necessarily detained from the meeting.

Thirty-three years ago he deposited with the society the only collection it then possessed; now it has one of the finest collections owned by any society.

He spoke of the lack of knowledge of natural history and of neighborhood history, urging that those studies be taken up in our public schools. He also spoke of the progress which had been made in arriving at conclusions, formerly by theory which was often at fault, now by science which rarely errs.

Rev. FIELDER ISRAEL spoke of the work and influence of the society, and of the elevating and refining influence of the study of nature, at the same time making appropriate reference to the valuable services of the President, and to the pleasure which Deacon Fowler, the only survivor of those men present at the meeting of fifty years ago, must experience in being with us here to-day. He also alluded to the prospective influence of the society, and closed by offering the following vote which was adopted:

Voted, That the cordial thanks of the Essex Institute are due to Col. T. W. Peirce for his very generous hospitality in opening his house and the grounds of his fine estate for the gathering of to-day, and for the abundant and refreshing supplies furnished at lunch.

Also to the gentlemen having in charge the Town Hall for the gratuitous use of said hall for this meeting.

NOTES ON THE CONDITION OF ZOÖLOGY, FIFTY YEARS AGO AND TO-DAY: IN CONNECTION WITH THE GROWTH OF THE ESSEX INSTITUTE.

BY E. S. MORSE.

A most natural and appropriate theme for discourse on this, the fiftieth anniversary of the Essex County Natural History Society, would be a review of the sciences and their progress during the last half century. So wonderful and prodigious has been their growth however, that neither time nor strength has permitted the preparation of such a review. In lieu of this we may with propriety run back to the time of the first organization of this society, one of the first of its kind in the country, and contemplate the condition of affairs then, and the attitude science presents to-day.

At that time the burden of general discourses on zoölogical science was mainly of an apologetic nature. We were invited to steal away from the perplexing cares of life to quiet retreats and soothe ourselves in contemplating the beauties and wonders revealed to us in the products of nature's handiwork. Newton's apple, Young's soap-bubble, and Galvani's frog, as illustrations, were always at hand to show what great fields of research had been opened by the observation of simple facts; but fifty years have rendered science such a power in the world that its study no longer requires an apology. Indeed, so many and such wonderful results have grown out of the most trivial beginnings that, nowadays, a man might thoughtfully and systematically study the flight of motes in the air and still be regarded as sane.

Every established fact in nature, however insignificant it may seem, is of importance. To-day, as well as fifty years ago, one might indeed find rest and infinite pleasure in turning from the tiresome thoroughfares of activity to a contemplation of nature's marvels. And herein lies the very great difference between the Society of Natural History fifty years ago and similar associations of to-day. The work done by these societies in past times is now relegated to the individual care of those who wish for a relief from the strain of business activities. Hogarth, in a letter to Ellis, portrays very well the spirit that animated many of the workers of the past, as expressed in the prefatory pages of their works. He says: "As for your pretty little seed-cups, or vases, they are a sweet confirmation of the pleasure Nature seems to take in superadding an elegance of form to most of her works, wherever you find them. How poor and bungling are all the imitations of art! When I have the pleasure of seeing you next we will sit down — nay, kneel down if you will — and admire these things." The societies of to-day, if they are to be of any use, must be cared for by trained and salaried specialists. In past times a few genial and pleasant people sauntered leisurely through the cabinets and admiringly examined the graceful shell or curious fossil. Now thousands of eager and critical students throng through the same halls, hungry for the impressive lessons that greet them from every case.

Through the all-embracing doctrines of evolution, man has awakened to the vivid realization that he is part and parcel of the domain of nature, which he had heretofore studied as a matter apart and beneath him. The realms of thought opened by Darwin show how intimately he is connected with the animals below him, and that somehow his welfare, moral and physical, is to be affected by a

more intimate knowledge of the life history of those creatures which he had only regarded with a curious eye.

The record of this society is one that may well excite pride, not only for the great work it has accomplished, but for the dignity of its past history. Its first journal was issued nearly fifty years ago, at about the same time with the journal of the Boston Society of Natural History and its publication had only been anticipated by those of the American Philosophical Society, the American Academy of Arts and Sciences, which dates from the latter part of the last century, the Philadelphia Academy and the New York Lyceum of Natural History. Indeed, these societies had issued but few numbers of their publications, when this institution, as represented by the Essex County Natural History Society, published the first number of its journal, and since that time a continuous series of scientific papers has issued from its councils.

Another matter for congratulation is that this society has always kept true to its name. It has been wholly for the benefit and in the interests of the good old county of Essex. Public meetings to the number of over two hundred in all, have been held in every corporate town in the county, with but one exception; and the enthusiasm of its members has often led it beyond the limits of the county and of the state. These excursions have gone into out-of-the-way places,— little villages, crossroads and hamlets by the sea. In short, the society has met in sixty-eight localities outside the corporate limits of Salem.

To these places has the society induced the celebrated naturalists of the country to bring the results of their researches, and the latest and freshest fruits of science. Agassiz, Wyman, Rogers, Jackson, and the younger generation of naturalists, Putnam, Verrill, Hyatt, Packard, Scudder, Allen, Coues, Dall, Gill, Kingsley, Robin-

son, Emerton and a host of others, have from time to time addressed the citizens of this county on almost every conceivable topic within the domain of natural science, while papers and memoirs from their pens have enriched the pages of your publications.

No better evidence can be adduced of its county character than the fact that its members are by no means confined to Salem, but are found scattered throughout the county, and the further fact that this important anniversary is being celebrated not in its halls at Salem, but here in this beautiful town of Topsfield.

In further evidence of the fact that it is a county society, it has especially aimed at forming a collection of the animals and plants of Essex County, and through the devotion of Putnam, Cooke, Richard H. Wheatland, Robinson, Sears, Emerton, and many others, it has brought together a local collection of the first importance in this country. It can be said, without fear of contradiction, that in no other society in America can so complete and exhaustive a local collection of animals and plants be found, as has been brought together by this society. A general review of this nature will not permit us to point out the numerous species new to science or forms new to the state which have been added by these assiduous efforts.

Let us glance at the first volume published by the society nearly fifty years ago, and catch a glimpse of the poverty of resources with which these early pioneers heroically set out in their task. In this volume was published a catalogue of books, the working tools of a naturalist. A few of our lunch baskets might have held the entire library, and this collection consisted of a few volumes of the transactions of the Philadelphia Academy, and the opening numbers, with pages freshly cut, of one or two other societies, containing the germs of American zoölogy

and botany. This material consisted almost entirely of specific descriptions and the modest establishment of a few new genera. Outside of these publications, with the exception of works by Audubon, Nuttall, Wilson and a few others, there was absolutely nothing to which the student could refer to aid him in his studies. Since that time what wonderful progress! States with their organized scientific surveys, fish commissions, state boards of health, mindful of the germ theory of disease, and above and beyond all, the stupendous achievements of the United States Government Surveys with their great libraries of publications freely distributed throughout the land!

When our venerable president, Dr. Wheatland, first taught the young and ardent naturalist Stimpson the mysteries of dredging from a dory, how little could he have anticipated that within so short a time a United States' steam vessel, fitted with dredges and all the paraphernalia of deep-sea collecting, and attended by a corps of trained naturalists, should visit the county for several successive seasons for the sole purpose of dredging, and that this government and European governments should sustain expeditions for the purpose of dredging in the deepest abysses of the ocean!

At that time there was not a single text-book of zoölogy in our schools; now, nearly every high and classical school in the land has its classes in zoölogy and botany. Then not a college in the land with its special professor of natural science; now, every college with its special instructor in those branches and with rapidly growing museums. At that time not a single popular periodical devoted to these sciences; now, a number of illustrated weeklies and monthlies with large circulation. And here it is a matter of pride to state that the first and among the most important of these magazines, the American Natural-

ist, came into existence under the support and patronage of the Essex Institute, whose name it bore upon its cover during its earliest years, having in reality been founded and edited by one of its members.

At that time the newspapers recognized science by publishing now and then short paragraphs about five-legged kittens, or accounts of the hackneyed drop of water with its myriads of animalcules disporting within. Now, the freshest results of science published in technical language appear side by side with the gossip of the town. A comet appearing then was dismissed with a paragraph of a few lines or an apostrophe in the poet's corner. Now, the daily paper publishes a whole broadside about the subject from the pen of some able astronomer and illustrated by diagrams. It is safe to say that the daily newspapers of the country in a single day publish more strictly scientific matter than could be brought together in all the pages of a scientific library of fifty years ago. At that time a few men with unvarying monotony akin to an inherited instinct were recording the daily winds and temperatures; now, we have an organized meteorological bureau whose weather predictions have excited the admiration of the world.

At that time the science of archæology was not born. Evidences of the high antiquity of man had been brought forward only to be rejected as contrary to Jewish chronology; now, it is the most vigorous and aggressive of all the sciences, and one of Essex County's gifted sons, Mr. Putnam, whose name has been so intimately identified with the work of this society, is at the head of an endowed museum of archæology at Cambridge, and is for the first time teaching the country the proper and only way of exploring the mysterious mounds of the West. His discoveries thus far have revealed such rich fields

of research in our country that one is led to wonder that a single penny should ever be spent abroad for work of this kind while so much remains to be done here.

To come nearer home. At that time the unrivalled ethnological collections of the East India Marine Society could be got access to only by soliciting permission from some one of its members, most of whom at that time were scattered over the world in the interests of Salem's commerce. Now, through the liberality of the great Essex philanthropist, in founding the Peabody Academy of Science, and the wise administration of its trustees, these invaluable collections are open daily, free to all, and a throng of forty thousand people annually pours through the open doors. Liberal provisions are made to augment these collections and the additions in the past ten years have outnumbered the original collection. The biological collections of this society, as well, have been cared for in the same manner and are equally accessible.

As to the growth of the Institute it is a matter of wonder and pride that, until recently without special funds, save what it derived from the annual assessments of its members, it should have obtained the position it holds to-day.

It is almost pathetic to read the first address by Prof. John L. Russell before the society in 1836, and see how meagre were the possessions over which its members were felicitating themselves. Mr. Russell speaks in glowing terms of the "spacious and commodious halls, furnished with elegant and useful cabinets" and the library of one hundred volumes! And this was absolutely all: a few heroic members paying out of their own pockets in disproportionate sums the funds necessary to sustain even this display. How faintly could he have conceived that within fifty years this society should have grown to one of three hundred and forty members, with a library

of thirty-eight thousand volumes and invested funds to the amount of fifty thousand dollars.

While this prosperous growth is due in part to the rich intellectual soil from which it sprang, a very great credit is due to the unselfish and unceasing labors of its one persistent associate, our devoted president, who has been with it from its inception and who as an officer has been intimately connected with it at every stage of its development.

It is not a little remarkable that an organization embracing, as it has for thirty-five years, an historical as well as a natural history society, should have received from this man impartial solicitude and attention. Voluminous papers and memoirs, historical and biological, have been published in its proceedings. Matters pertaining to both subjects have often come up for discussion at the same meetings, and yet there have been no dissensions nor jealousies between the two branches. No factions have developed. The curse of political methods has never entered its councils. Perhaps it augured well for the society that its first act of incorporation was signed by educators and statesmen, by Horace Mann, then President of the Senate and Edward Everett, Governor of the Commonwealth.

Surely such harmony indicates the patience and sagacity with which its work has been guided. Certainly the highest compliment our president could receive is, that during the space of fifty years in which time he has successively held all the offices to the highest, he has been heartily seconded in every effort for its welfare.

With all this vitality and growth, this society is the only one of any age and importance in the country that has never had a home of its own. The Portland Society of Natural History, though twice burned out, has still a

building of its own. The Boston Society of Natural History, the Antiquarian Society at Worcester, not to mention other societies throughout the country, occupy buildings which they possess through the liberality of their patrons. This society, on the contrary, has had to hire rooms from the moment of its inception to the present time. Its name has been carried, on its publications, to the four quarters of the globe, yet it has never had the supreme comfort of seeing permanently wrought in stone over its own door the name which has done the county so much honor and credit at home and abroad.

At present it finds accommodations in rented rooms in a building far from fire-proof where it has stored away portraits and manuscripts of inestimable value, and its shelves fairly groan with the weight of its library accumulations, yet no citizen of the city or county has been prompted to perpetuate his name by securing for this worthy society a permanent habitation suited to its rapidly increasing needs.

In fifty years the society has attained more than its most sanguine friends could have hoped for. May it not be many years before successful efforts shall be made to secure a solid and fire-proof structure over whose portal the name of the Essex Institute shall be wrought in enduring stone, as a memorial of the past, and an inspiration for the days to come !

THE PROGRESS OF BOTANY IN ESSEX COUNTY DURING THE LAST HALF CENTURY, ESPECIALLY AS INFLUENCED BY THE ESSEX COUNTY NATURAL HISTORY SOCIETY AND THE ESSEX INSTITUTE. 1834–1884.

BY JOHN ROBINSON.

ONE of our older botanists has said that the careful study of the flora of a very limited region might well occupy the lifetime of any person, and that the result accomplished would contribute more information of real value to science than any general work the same individual would be likely to undertake successfully.

This sentiment applies to the institution as well as the individual. Too often we see the local scientific society striving, not to emulate the spirit, but actually imitating the work of state or national institutions, totally neglecting, all the while, the more important duty of first presenting to the public a complete exhibit of the natural products of the fields, the forests, and the waters of the immediate neighborhood, and of encouraging an earnest study on the part of the people, especially the younger, of the natural objects met in every-day life, with which it is safe to say few are at all well acquainted.

How many persons outside of a scientific class should we be likely to find who could, even to-day, readily and correctly give, in outline, the life-history of a single animal or plant? We find many persons who are familiar with the common field flowers, but how many of these could tell us a word of the grasses or sedges, or, give us even the common names of half the forest trees growing naturally in our own county of Essex? And yet, in the whole course of botanical investigation, there are no plants

so common as grasses or so conspicuous as the forest trees; there are none of more value considered economically and none of greater importance to the practical farmer and mechanic. Happily, however, it cannot be said that the Essex Institute has materially erred in this direction, as may be shown to-day, by the present excellent local herbarium originally begun by the Essex County Natural History Society and the numerous natural history field-clubs, children, so to speak, of the Essex Institute, successfully established in various parts of the county, whose members hold their meetings and collect and study the native plants and animals.

To consider the progress of botany in Essex County for half a century three points present themselves: (1) The condition of botanical knowledge now as compared with that of fifty years ago. (2) The progress made in fifty years' work here, as shown by the increase of libraries, public museums, private herbaria, etc. (3) The practical benefit and general knowledge bestowed upon the people of the county by such increased accurate knowledge of the subject and the facilities for obtaining it.

Prior to 1834, the young zoologist had little in the way of books or collections to aid his studies. Throughout the county but few students of animal life had been developed. No convenient text-book had then been written applicable to this region, and many of the common forms, among the lower animals, had not even been described. The expense and difficulty of preserving specimens prevented the formation of private collections in many departments. In this part of the country, the museum of the East India Marine Society had alone attained any considerable size, and that collection was only open to the public as a special favor and contained but little in the way of specimens illustrating local natural history.

The railroads had not been built, and stage communication was so slow and expensive that the young student could not run to Boston or Cambridge of a holiday to consult libraries and collections even had they existed, as now, in those places.

With the botanist, however, it was somewhat different. Although the life-histories of plants were little known, and the theory of natural selection and evolution from lower forms was comparatively unheard of, and species were more considered than morphological relations; yet, in Dr. Jacob Bigelow's "Florula Bostoniensis," first printed in 1814, the second and enlarged edition of which had appeared in 1826, the young botanist had the golden key which should introduce him to an intimate acquaintance with nearly every flower and tree his path might cross, in any ramble, hereabouts, and through this acquaintance with their names and natures lead him to the closer study of their structure and morphology. To those of us who are only familiar with the study of botany to-day it is difficult to realize the importance of Dr. Bigelow's little volume, or the labor and study expended in its preparation. Begun as a sensible recreation from his arduous professional labors, it became the standard for all botanists in this part of the country, and, for more than a third of a century held the ground undisputed, until the larger and more elaborate works of Dr. Asa Gray superseded it.

The study of botany in Essex County, we may say in New England, properly dates from the time of Rev. Manasseh Cutler at the close of the last century. Early writers as Francis Higginson, John Josselyn, William Wood, John Winthrop and others refer to the native fruits and flowers. Josselyn published the well known "New England Rarities Discovered," an edition of which

has been prepared in recent years with valuable notes by Professor Tuckerman, and Higginson in a letter written from Salem in 1629–30 (Mass. Hist. Coll., Vol. I, p. 121) speaks of the "Flowering Mulberry," or Raspberry, and "Chervil," or Sweet Cicely, as growing near Salem in places, where certainly, until a very few years, these interesting historical plants still flourished. None of these writers can, however, be considered as Essex County botanists, and it is not until the close of the American Revolution that we find any serious or scientific study of the plants of the county. Manasseh Cutler of Hamilton, after his varied services as revolutionary chaplain, lawyer, pastor, doctor, reformer and pioneer, found time to prepare in 1783–4, as the title of his paper, says: "An account of some of the vegetable productions growing in this part of America, botanically arranged." This was published in the first volume of the "Memoirs of the American Academy of Arts and Sciences" which was printed in 1785, where some three hundred and fifty species of flowering plants were described and several important scientific points suggested which have since been adopted in botanical treatises. It was his intention to extend this work, and several manuscript volumes are now in existence prepared toward this end. Dr. Cutler's paper bears the date of presentation Jan. 26, 1784, and, therefore, we are not only celebrating to-day the semicentennial anniversary of the first organization formed in Essex Country for the study of botany and kindred subjects, but the full centennial anniversary of the presentation of the first work upon the flora of Essex County by the first Essex County botanist.

Following Cutler came Drs. George Osgood and Andrew Nichols: the former contributed notes for Bigelow's "Florula Bostoniensis," and the latter delivered, in 1816,

a series of lectures on botany, the first of such given in this part of the country. Dr. Nichols was later one of the founders of the Essex County Natural History Society and its president, and thus has had an important influence upon local botanical work. In 1823, two young men, both destined to be long remembered on account of their contributions to botanical knowledge, began their work in Essex County. These were William Oakes of Danvers, later of Ipswich, and Charles Pickering, then spending much of his time at the homestead of his grandfather Col. Timothy Pickering at Wenham.

Oakes, disgusted with the law, his chosen profession, became the first critical botanist of the region, and at this time converted Dr. Pickering from conchology, a study he had first chosen, to botany.

Oakes botanized with Pickering extensively in Essex County, particularly in the Great Swamp, Wenham, a region then almost in its pristine wildness. Oakes afterwards prepared a list of Vermont plants for Thompson's history of that state, and had in contemplation a work on the plants of New England, which, owing to the appearance of Beck's Botany, was never completed. His most elaborate work was a folio volume on White Mountain scenery illustrated by Sprague, which, however, was not published until after his death in 1848. Oakes was impulsive and generous, and thoroughly in earnest in his favorite study. Like many men of note he was but little appreciated while living, yet no monument could have been erected to make his memory more cherished and his labors more respected than that which he left behind : an extensive collection of beautifully prepared botanical specimens determined with faultless accuracy, a portion of which formed the nucleus of the present county botanical cabinet now in the hands of the Peabody Academy of Science in Salem.

Dr. Pickering, in 1838, joined the Wilkes Exploring Expedition, of which he had been appointed the naturalist, and from that time until his death in 1881, his entire life was devoted to important works on zoology and botany.

We thus find in 1834, at the time of the foundation of the Essex County Natural History Society, a strong impetus had been given to the study of botany, beginning at Cutler's time and continuing directly to this date, through those who had been the disciples of Cutler himself, and that, developed at the same time, through a different channel, however, Bigelow's Botany had reached its second and enlarged condition.

For the systematic student, therefore, the path was made easy. In the departments of vegetable physiology the works of the older authors were accessible to those who could cope with the Latin, in which language they were chiefly written. Sprengel, the forerunner of Darwin, had, forty years before, published his work on the fertilization of flowers, which, however, was but little known; Andrew Knight had followed in 1800; Hale's experiments with the sunflowers were published and pictured, and the Jussieus, Schacht and Schleiden had swelled the writings on these and kindred subjects.

It is not to be wondered, therefore, at the first meetings of the new society, and later at those of the Essex Institute, that the subject of botany should have absorbed a large share of the time in its consideration, and that horticulture, its close kin, should develop in our midst even to becoming the mainstay of the Institute in its early and less prosperous days by furnishing the attraction to its rooms for the outside public, and through the proceeds of the regularly conducted exhibitions replenish the often scanty exchequer.

But even with the advantages these men thought they

possessed, how should we, to-day, think to accomplish any important results? The microscope furnished by Mr. Cole, the liberal amateur, was too costly a piece of mechanism to be even hoped for, except by few. Drying paper could not then be had, cheaply, at any natural history store. Indeed, no natural history store itself then existed. Horse-cars and steam railroads were not at the doors and street corners to take the collector swiftly to the woods and fields. Yet, patiently and surely, the work proceeded and collections were formed and new truths discovered.

To-day five editions of Asa Gray's Manual of Botany are broadcast over the land and countless variations, by his publishers, of Dr. Gray's other works are with it. Alphonso Wood has scarcely fewer followers, while the publications from innumerable other authors bring up the rear. Works on local floras are abundant. A good compound microscope can be had by almost any thrifty botanical student, and an excellent magnifying glass can at least be owned by all. Drying paper is on sale, as are also regulation size herbarium sheets and genus covers, in almost every city. Herbaria for consultation are everywhere accessible. We can run off in the cars, collect our box of plants, and be back to dinner, or, to Boston or Cambridge for consultation and exchange of ideas as quickly. In fact, we live in an age of such unheard-of advantages and luxury that, doubtless, we do not appreciate our privileges and have not half respect enough for the botanists of fifty years ago. The change is none the less marked to the student of vegetable physiology than to the collector of plants. Charles Darwin has come upon the scene and left it again, but left behind him an impression never to be effaced; he has revolutionized botanical study in many of its branches as much as he has that of zoölogy.

Gray has given us in the text-book of structural botany an almost perfect work, while translations of Sach's great volume are in most libraries, and, besides, almost every mail brings to our table magazines devoted specially to botanical research, filled with the latest information from every quarter of the globe. In short, the study of botany from being looked upon as merely including the collecting and naming of plants, has been shown to be of a widely different nature in its highest aims; the study of the life-history of the individual and its relations to other forms. No longer do we draw an impassable line between the flowering plants and cryptogams; recent study proves that no such line exists. Instead of a mass of disconnected members we are taught to see a graduated line reaching from the humblest one-celled alga to the loftiest and most highly developed monarch of the forest.

And what then are the visible results in Essex County of this fifty years of labor?

The nucleus of the herbarium begun by Oakes and Nichols has grown into a collection including some 4,000 sheets of mounted plants and 200 wood specimens, representing nearly 1,700 species of plants, native or naturalized in Essex County, besides a reference collection of about 10,000 specimens from all parts of the world, all of which is now neatly arranged and properly cared for by the Peabody Academy of Science, at whose rooms it is open for free consultation by any botanist in the county. With this collection are the latest botanical reference books and microscopes for the use of students. Lectures and instruction in botany have formed part of the regular work of the Academy, where classes have regularly been conducted for several years. At the evening meetings of the Essex Institute many papers of value on this subject have been presented, while the influence of the two hun-

dred field meetings, which the Institute has held in all parts of the county, cannot even be approximated. The last important work in this direction was the Catalogue of the Flora of Essex County, a volume of two hundred pages, published by the Institute, in 1880.

Many museums, societies and clubs have sprung up throughout the county, and we frequently see in the local press accounts of the meetings of the "West Newbury Natural History Club," the "Cape Ann Scientific Association," the "Boxford Natural History Club," or those of similar organizations in Lynn, Georgetown, Amesbury, Marblehead and elsewhere. Many of these societies, as well as some of our educational institutions, possess valuable herbaria, and in several instances lists of the floras of the towns have been published. Of private collections it is impossible to speak. Their number is legion; many are confined to special groups, as trees, ferns, grasses, mosses, sea-weeds, etc. Some are more general in character, and many are both extensive and valuable.

We could extend this enumeration to many pages, but the brief outline here given must suffice to indicate these visible results.

Of the influence exerted upon the people, as a whole, and of the increase of students on these subjects it is more difficult to speak accurately.

Fifty years ago, William Oakes, searching on hands and knees for half an hour, to obtain a few capsules of a rare moss, was thought, by a worthy country woman who had watched his movements, to be a harmless insane person, and, in simple kindheartedness, she took him a slice of bread and butter. It is doubtful if such a thing could happen now, although it is not unusual for the botanical collector to be curiously questioned as to the commodity he has on sale in the green box, or to be addressed from

the second story window of some house at which he may called for a drink of water after a dusty walk, being mistaken for a marauding tramp.

There is, however, no doubt that the general information of the people of Essex County, on the subject of botany, has vastly increased. The importance of the relations of certain insects to flowers is now so generally known that it would hardly be possible to find a community so stupidly ignorant as to be jealous of a neighbor's honey bees and almost drive him from the town in consequence, and this did actually happen in Essex County thirty years ago.

The distribution of useful scientific information through the county, and agricultural papers, is now so widely felt, and scientific lectures are so numerous, even in the smaller towns, that notions and superstitions, born of isolation and seclusion, are vanishing as mists before the morning sun. No longer do the former utterances of the lecturer or the writings of the essayist satisfy the growing demand. Mere accounts of habits and classification are still satisfactory to a juvenile audience, but for the maturer mind a deeper and more philosophical theme is required. Scientific books are more read and hence are more extensively purchased by the libraries. The benefits are twofold. Superstition is banished, and observation and rational thought encouraged.

This institution cannot, of course, be credited with all this change and improvement. Other forces have been steadily at work. The labors of our ancient and most excellent Essex Agricultural Society and its farmers' institutes, are an important factor not to be overlooked. The press and the pulpit have grown and developed immeasurably also, and have had their powerful influences brought to bear in the right direction, and natural

history has been introduced as a regular study in our higher grades of schools. Yet this institution has done a lion's share. Beginning before others, it has been as the leaven for the whole lump, preparing the people for all truth and wisdom. It has encouraged those who needed encouragement and offered facilities to those ready to work. Through its publications it has furnished the medium for the expression of ideas and the presentation of the results of scientific investigations, and it has sustained, at home and abroad, a reputation for Essex County as a scientific and intellectual centre. It is an honorable record, and this institution may well be proud of the result of its fifty years of labor. And in connection with this work the names of Cutler, Oakes, Pickering, Osgood, Russell and many other botanists will always be remembered with gratitude. They helped each other, and though all have passed away the result of their work will be a help to every future botanist who shall collect or study in Essex County.

Nor can I close without expressing my personal indebtedness to my old and honored friend, our president. To his belief in the necessity of encouraging the young student is in a great measure due the perpetuation of the institution be helped so ably to begin. He has ever believed that young laborers and new men must be engrafted on the old stock. I feel for myself as I know it has been with others, that what I have enjoyed of botany, of natural history generally, of museum work, is due to the encouragement given and the trust placed in me by him when I was but a boy, and if I have added the least of value to the work of those who have preceded me, it is the result of the stimulus coming of such encouragement and trust.

GEOLOGY AND MINERALOGY IN ESSEX COUNTY, MASS.

BY B. F. McDANIEL.

THE first organized effort in the United States for the study of geology and mineralogy was the "Mineralogical Society," formed in New York city in 1798.

In appealing for aid and sympathy, information was especially desired as to the localities, quantity, and quality of gunflints, brimstone, saltpetre and lead.

Evidently the society meant to justify its existence. The state of the science is forcibly revealed by Professor Silliman, the elder, in 1818. "Notwithstanding the laudable efforts of a few gentlemen," he says, "to excite some taste for mineralogy, so little has been effected in forming collections, in kindling curiosity, and in diffusing information, that only fifteen years since (1803), it was a matter of extreme difficulty to obtain the names of the common stones and minerals; and one might inquire earnestly and long before he could find any one to identify even quartz, feldspar, or hornblende among the simple minerals, or granite, porphyry, or trap among the rocks.

We speak from experience, and well remember with what impatient, but almost despairing curiosity we eyed the bleak, naked ridges which impended over the valleys and plains that were the scenes of our youthful excursions.

In vain did we doubt that the glittering spangles of mica and the still more alluring brilliancy of pyrites gave assurance of the existence of the precious metals in those substances, or that the cutting of glass by the garnet and quartz proved that these minerals were the diamond; but,

if they were not precious metals and diamonds, we in vain inquired of our teachers what they were."

In the next twenty-five years, interest in this science rapidly increased. In 1825 Dr. Samuel Robinson published a "Catalogue of American Minerals," an octavo of 300 pages, giving the localities of all known minerals in the United States and British Provinces. Prof. Parker Cleaveland's "Treatise on Mineralogy and Geology" was first published in 1816, and marked an epoch in American science.

In 1824, North Carolina, the first state to take such action, authorized a geological survey.

In June, 1830, Massachusetts commissioned Prof. Edward Hitchcock to do the same work for this state. Other states followed, until now the whole extent of the country has been or is now being surveyed.

It is here to be noticed that the sciences of geology and mineralogy have made great and important strides away from the comparatively primitive knowledge and methods of the early part of this century. Then the terminology of both sciences was largely based on the external appearances of rocks and minerals. Hence an imperfect classification and many errors. The long and fierce quarrel between the Wernerian or Neptunian, and the Huttonian or Plutonian schools of geology had not yet settled down into the present dispassionate weighing of evidence.

The science of geology was not yet free and independent, but was subjected to tests and made to do duty in foreign fields, where its development was checked.

But the practical study of geology and mineralogy won many minds who cared little for speculative discussion, and who, indeed, did not feel competent to master the abstract principles of either science. The early local scientific societies were not largely made up of scientific men, but

of those whose hearts were touched with the beauties and wonders of nature, and who wished to sit in her school as humble disciples.

They were observers, with the true passion for knowledge,—explorers, whose zeal carried them through many difficulties and hardships, and rewarded them with many brilliant discoveries. Such were the early workers in the field of geology in this county.

The Essex County Natural History Society and its successor, the Essex Institute, have given their attention almost wholly to botany, zoölogy and prehistoric archæology, owing to the bent and profession of their leading members. In these directions they have given the Essex Institute and the Peabody Academy of Science a world-wide reputation. Had the same thorough and continuous work been done in the fields of which this paper treats, I believe that results hardly less brilliant and helpful to science would have been realized.

The geology of Essex County is not rich in metalliferous deposits, nor even as far as we know in valuable minerals; but both Rockport and Newburyport have yielded surprises to the older mineralogists, the former giving two new species to the science. Dana gives but eight towns in our county as mineral localities, one of which, the sodalite of Salem Neck, is only a reminiscence. Other localities have been named by Hitchcock and others, but little has been taken out of them. For instance, the evidence for the existence of the Topsfield copper mine rests at the bottom of the Atlantic. Geological and mineralogical investigation has been pursued here in a desultory way.

In the first three volumes of the Proceedings of the Institute are preserved the accounts of the early labors in this department. I will now briefly review them. Two

of the most eminent mineralogists of that time were Dr. Charles T. Jackson and Mr. Francis Alger. They attended the second field meeting of the Institute at Lynnfield, in July, 1849. The serpentine ledges there, like those in Newbury, then gave promise of a rich output of decorative marble.

It is unfortunate that this promise has not been realized. From an extensive acquaintance with the formation at Newburyport, I am satisfied that the deposit there may yet yield handsome returns for a comparatively small outlay.

The name of Dr. Andrew Nichols, of Danvers, early appears among the earnest and intelligent naturalists in the ranks of the Institute.

In a notice of his death, at the annual meeting, May, 1853, hearty testimony was borne to his noble work in the several departments of natural history prosecuted by the Institute. Nothing in the natural world escaped his questioning mind, and his power of imparting the results of his studies was equally felicitous. To him, it was said, we owe a great deal for the development of natural science in this county.

Dr. William Prescott, of Lynn, afterwards of Concord, N. H., where he died, was another earnest spirit and ready helper. He studied enthusiastically the geology and mineralogy of his neighborhood, and contributed generously of his stores to the cabinets of the Institute.

I was present at the sale of his collections in Concord, which were very large and rich, but like all such things sold at auctions, suffered a grievous slaughter.

The Rev. A. P. Chute, of Lynnfield, was another efficient worker in these fields. At the several meetings held at that place, Mr. Chute showed evidences of earnest and intelligent work. January, 1856, he made a report

to the Institute on the sodalite found on Salem Neck, which Mr. D. M. Balch reported on again more thoroughly in 1864. At a field meeting in Lynnfield, in Oct., 1856, Mr. Chute displayed cabinet specimens of chlorite, epidote, smoky quartz, fluorite (white and purple), feldspar, albite, pyrites, magnetite, siderite, magnesite, serpentine and manganese, the last probably dendritic, that he found in that town.

In 1857, Mr. B. F. Mudge, of Lynn, appears among the Institute workers in the field of geology. At the field meetings in Lynn, Nahant and Lynnfield, Mr. Mudge rendered efficient aid in his department, and in other ways at other times served the Institute. He gave the names of fifteen minerals that he had found in Nahant.

Mr. J. J. H. Gregory, of Marblehead, appears as early as 1858 among the active forces of our society, admirably filling the place made vacant by Mr. Mudge's removal to the west. He has been a faithful attendant and valuable helper ever since, the Proceedings of the Institute bearing witness to the diligence and intelligence of his geological studies. In Sept., 1858, Mr. Gregory read a paper on "The Geology of Marblehead," which, with such additions as more recent research might offer, might profitably appear among the publications of the Institute.

In 1860, Mr. D. M. Balch became curator of mineralogy. The Proceedings of the Institute bear record to his fidelity and competency.

Jan. 7, 1861, Mr. S. S. Mackenzie presented a paper on "The Geology of Topsfield," showing close and careful observation, but offering little of interest to the mineralogist.

Like all of our towns, Topsfield was early agitated by the gold fever, iron pyrites being in nearly all cases the

gay deceiver. One Smith, digging a well in this town, found a lump of what he supposed to be gold, and placed it on the mantle in his house. One day a stranger called and asked for a drink of cider. While Mr. Smith was absent in the cellar drawing the beverage, the visitor departed, taking the tempting mineral with hım. A circle drawn with chalk on the floor showed where he had last stood. It is needless to suggest who the stranger was held to be.

In 1861, Rev. Stillman Barden reinforced the ranks of the Institute workers in the field we are now considering, and until his death contributed generously by voice and gifts of specimens to elucidate the geology of the county. Called to live at Rockport, he was the first to develop the mineral treasures of that place.

At field meetings held there in August, 1862, and August, 1863, he won the cordial praise of Dr. Chas. T. Jackson, Mr. Francis Alger and Prof. Alpheus Hyatt for his enthusiastic and intelligent labors in that interesting field; thereby the attention of trained scientists was drawn to the locality, and two new species discovered, besides the more accurate definition given to those already known.

In July, 1867, at a field meeting held in Andover, Prof. C. H. Hitchcock made an address chiefly in explanation of the kames or glacial ridges in that town and section. The study of these formations has since been ably pursued by Rev. George F. Wright, lately of Andover, now of Oberlin, Ohio, and two communications made by him to this society have been published in pamphlet form. This has been the first thorough, systematic work done by an amateur. That it has won the recognition and hearty approval of professionals has been simple justice, for no trained scientist could have more fully met

the conditions of his work than has Mr. Wright. His removal from the county is deeply to be regretted.

Following the meeting of the American Association for the Advancement of Science in Salem in 1869, a number of its members made a visit to Rockport, under the auspices of the Institute. Col. J. W. Foster, the eminent archæologist of Illinois, and Professor T. Sterry Hunt, made interesting and valuable addresses at the meeting there gathered.

The work I have mentioned has been largely done in a desultory way, and by untrained local students. Prof. Alpheus Hyatt and others had given some attention to our local geology, and in May, 1871, Professor Hyatt read a paper before the Institute on this subject.

This marked the beginning of a thorough detailed study of the district. Prof. Edward Hitchcock, in his report and map of 1841, and Prof. C. H. Hitchcock, in his map of 1871, had drawn the substantial geological features of the county; but as scientific views change rapidly and often radically, Professor Hyatt, in his more minute and recent investigations, found reasons for differing from their conclusions. He made a detailed map in colors of the geology of Marblehead Neck, which is now in the Mass. Institute of Technology.

Mr. M. E. Wadsworth, of the Boston Society of Natural History, and Prof. T. Sterry Hunt (see his "Chemical and Geological Essays") deserve mention for valuable, original work on the geology of this region.

Professor Hyatt's work has been taken up, and under his direction carried to greater completeness by Mr. W. O. Crosby, by whom a map and report were prepared under the patronage of the Mass. Commission to the Centennial Exhibition in 1876. In this report we have the first detailed and comprehensive statement of the geology

of Essex County, based on intimate personal study in the field.

But Mr. Crosby did not stop with this brief exposition. He prosecuted his work in the field and laboratory, and in 1880 published an octavo volume of two hundred and ninety-five pages, with an accompanying map, entitled "Contributions to the Geology of Eastern Massachusetts." It appeared under the auspices of the Boston Society of Natural History, with which he is officially connected.

The volume is a worthy monument of years of careful research and study, but its author disclaims any pretensions to completeness. In the nature of the case, it cannot be exhaustive. Large tracts of rocks, that are needed to verify inferences, are covered by drift and water, and future explorations and quarry-workings must be looked to for the explication of some unsolved questions.

It is hoped that an abstract of Mr. Crosby's report, with a geological map of the county, will be published by the Institute for the use of our schools and public libraries.

My report has come to an end, but the work of which it treats may be said to have been just begun, in a way that will need no radical revision. It is a work to which all observing, inquiring minds can contribute.

The intelligent farmer in his fields, the teacher and her scholars in their rambles, whoever has eyes to see, can help the geologist to complete the story of creation written on the great stone leaves of the earth's crust. The rewards of such work lie in the discovered facts, without which man knows not all the beauties and riches of his earthly home, and even the commonest life is not complete.

AN HISTORICAL SKETCH.

BY SAMUEL P. FOWLER.

The Essex County Natural History Society was organized on the eighteenth day of December, 1833, in Salem. The officers of the society who were then elected were: Dr. Andrew Nichols of the old town of Danvers, president; Mr. William Oakes, of Ipswich, and Rev. Gardner B. Perry, of Bradford, vice presidents; Mr. John M. Ives, of Salem, secretary and treasurer; Rev. John Lewis Russell, of Salem, librarian and cabinet-keeper; William Oakes, of Ipswich, John C. Lee, of Salem, Thomas Spencer, of Salem, and Charles G. Page, of Salem, curators.

Andrew Nichols, William Oakes, William Prescott and their associates were made a corporation under the name of the Essex County Natural History Society, February 12, 1836. A circular, dated Jan. 1, 1834, was published and distributed, setting forth the object of the society, which was to promote more generally the study of natural history in the county of Essex.

We may further notice the gallantry of the men who formed this society fifty years ago in inviting ladies to join in their work, not because there was at that time any discussion concerning woman's rights, but because they well knew the fondness of the fair sex for flowers and the beautiful things of nature.

I am an old man, but in the course of my long life I have never yet met with a woman who would say she was not fond of flowers. In this circular they say em-

phatically, "Ladies, you will perceive, are not excluded, and it is anticipated that they will contribute much to the success of the society. Several in Salem have already become subscribers."

These anticipations have been more than realized. Ladies have always taken a deep interest in the society and its work, and have greatly aided us in many ways and by gifts of substantial value. It would be interesting to know who were the ladies who first became members of the society.

The first anniversary address delivered before the Essex County Natural History Society was by Rev. John Lewis Russell, June 15, 1836.

On the sixteenth day of April, 1834, the society held its first field meeting at Topsfield, at the hotel then standing on the line of the Newburyport turnpike.

The company came in carriages, as railroads were then unheard of. I came to the meeting in a chaise with Dr. Ebenezer Hunt. The following persons were present: Dr. Andrew Nichols, of Danvers; William Oakes, Esq., of Ipswich; Rev. Gardner B. Perry, of Bradford; Mr. John M. Ives, of Salem; Mr. Benjamin Hale Ives, of Salem; Rev. John Lewis Russell, of Salem; Dr. Ebenezer Hunt, of Danvers; and Samuel P. Fowler, of Danvers; and perhaps some others whose names may have escaped my recollection. Only one of those then present is now living. Several of the party brought with them specimens of natural history, Mr. William Oakes bringing several of the beautiful plates of Audubon's magnificent work on the Birds of North America. The field meeting which was held fifty years ago was much like those of the present day. Rev. Mr. Russell, when alluding to it in his address, says, "the season, the weather,

the day were auspicious. It seemed as if Nature herself was smiling on our prospects and inviting us to her study and acquaintance, the lovely Hepatica and pure Sanguinaria were blooming under our feet, and assisted to adorn our tables." After dinner a stroll was taken in the woods and fields, and among the plants gathered was a fine specimen of Blood Root (*Sanguinaria Canadensis*) which was taken up with a spade, and upon our return to the hotel it was placed on the middle of the table with a newspaper under it, when we pledged ourselves to sustain the Essex County Natural History Society and promote its interest.

To carry out this intention, the several persons who were known to be interested in the study of any particular branch of natural history were requested to bring forward to the field meetings such specimens as they possessed or might find in their rambles. All through those early days of the society our pledge was well kept, notwithstanding the laughter noticed on the countenances of some persons when told we were posy-seekers and bug-hunters. But neither the sneer of the unthinking nor "the world's dread laugh" for a moment deterred us from going forward in the study of the natural history of the county of Essex. Farmers and gardeners have since derived important knowledge from the labors of entomologists, and in consequence of the constant increase of injurious insects it has now become necessary to make entomology a study for the preservation of our crops.

The love of flowers, their study and cultivation, have greatly increased in these fifty years. Flowers are now used at most public meetings and gatherings and are seen in churches. They are now profusely used at the burial of the dead, when fifty years ago the only plant you would

have seen at a funeral was a handful of tansy gathered from the garden or roadside and thrown upon the coffin.

The Essex County Natural History Society has not become extinct, although its name was given up when it was merged in the Essex Institute, which includes both those who study the wonders of nature and those whose tastes lead them to search out the events of the past.

The Essex Institute was formed by the union of the Essex Historical and the Essex County Natural History Societies. To effect this end the two societies held several meetings during the autumn of 1847. A joint committee was appointed to draft a plan to serve as a basis of organization. The plan offered by the committee was accepted by the societies at a meeting Jan. 14, 1848. An Act of Incorporation, from the Legislature, was obtained in February of the same year; and on the first of March following, by its acceptance, the Essex Institute was organized and the following officers chosen: Daniel A. White, President; John G. King, John Lewis Russell and John C. Lee, Vice Presidents; Henry Wheatland, Secretary and Treasurer; Frederic Howes, jr., Cabinet-keeper; George D. Phippen, Librarian; Frederic Howes, Joseph G. Waters and Matthew A. Stickney, Curators of the Historical Department; William Mack, Henry F. King and Samuel P. Fowler, Curators of Natural History; Benjamin H. Silsbee, Francis Putnam and James Upton, Curators of the Horticultural Department; John C. Lee, Frederic Howes and Ephraim Emmerton, Financial Committee.

My esteemed and somewhat eccentric friend, the Rev. John Lewis Russell, a learned and enthusiastic botanist, when the union of the two societies was under consideration, expressed to me his fears that the subject of natural

history would be deemed of minor importance, and that many of the members absorbed in the subject of genealogy would devote more time to find out who their great-great-grandmothers were than they would to the study of natural history.

I said I thought the subjects of civil and natural history could be studied together to the mutual benefit of the members of the Institute. The fears of Mr. Russell have never been realized as time has proved. The records of our proceedings will show that the study of civil and natural history has continued side by side, to the neglect of neither, but to the advantage of both; and an interest in these subjects has been developed in the county, which I trust will continue and increase. I cannot close without a tribute of respect to those departed friends who were associated with me in the formation of this society, and whose memory I fondly cherish. I well remember their enthusiasm in striving to awaken among the people of Essex County an interest in the study of nature, and I cannot forbear to express my desire and my hope that their laudable examples will be followed by the young men and women of the present day.

A FIELD DAY AT ANNISQUAM

Wednesday, July 16, 1884.

A goodly number of the members and friends of the Institute spent a very pleasant day at this favorite seaside resort on the northern side of Cape Ann. The train made its usual prompt run to Gloucester; at the station, carriages were in waiting and soon the party were safely conveyed to the place of rendezvous, which was the post-office at Annisquam. This building appears to be the centre of the social life of the village. Not only do the U. S. mails arrive and depart with governmental precision, but the usual varieties of a country store are dispensed with courtesy and despatch; in the rear is a small hall in which our baskets, wraps, etc., were deposited and where the noonday lunch was laid. In the second story is a larger hall where the afternoon session was held.

The party spent the forenoon in rambling about the place. Some visited the Laboratory, established by Prof. A. Hyatt, an institution designed to cultivate the study of zoölogy, especially the marine; further reference to what was seen may be gleaned from Mr. Kingsley's remarks at the meeting. Some visited "Sunset rock" upon an eminence near by, which commands an admirable view of the broad Ipswich Bay, Plum Island with its nine miles of length, Agamenticus mountain in Maine and, occasionally, a glimpse of the Isle of Shoals. Some went to Dogtown, about two miles distant, which, many years ago, contained some forty houses, occupied largely by men who served their country during the war of 1812, and afterwards long continued to be the abode of the widows and orphans, especially of those who died on the battle field or who had gone down at sea; the last of them are still remembered

bringing to market the berries and herbs which yielded them a scanty support. They have now all passed away and the dwellings have also disappeared; the old cellars, the grass-grown roads and the traditions of the place impart an interest to this deserted hamlet.

Upon a point on the beach is the "Squam light," which was visited by some; others strolled upon the beach and gathered various specimens of natural history.

This is an interesting locality and its attractions have induced many to pass the heated term in the enjoyment of its cool and refreshing breezes.

The afternoon session was called to order at 2 P. M. by the President who, after a few remarks alluding to the pleasant meeting held at this place in August, 1872, called upon Mr. J. S. Kingsley, who is at present in charge of the Marine Laboratory which was visited in the forenoon, and who gave an interesting account of the history of the institution, the mode of management and its present condition. His remarks are embodied in the communication hereto appended.

Mr. JAMES S. JEWETT, of Gloucester, read a sketch of Annisquam, for which see Historical Collections, Essex Institute, Vol. XXI.

Prof. ALPHEUS HYATT followed. He expressed his pleasure in meeting his old friends, and said that he should always have the kindest feelings toward the Institute. In regard to the Laboratory he spoke of the philosophy of the instruction as distinct from the curriculum adopted in the various schools of learning. He then proceeded to give a short illustrated lecture or talk upon *sponges* which was very interesting and instructive.

A. C. PERKINS, Esq., formerly Principal of Phillips Academy, Exeter, now of Brooklyn, N. Y., Hon. JONAS

H. French of Gloucester and Hon. James Davis of Gloucester, offered interesting remarks. *The first*, after complimenting the Institute upon the value of its work, proceeded to read some extracts of a bright and humorous character from the note book of a zoölogical student. *The second* expressed regret that the Institute could not go farther on the Cape, visit the quarries and accept his invitation to visit his own house and grounds. Referring to the horticulture of the Cape, he said that, while he was prospecting with the view of laying out and embellishing his own grounds, he was visited by Mr. Copeland, a man of experience in such matters, who, after a walk in the woods with the view of discovering what local plants might be found, said that we had more desirable shrubs and other kindred growths than can be found elsewhere. *The third* said that he remembered the circumstance of the meeting held in this place in 1872 and recalled the details of that day's proceedings. He then gave a talk which he considered supplementary to Mr. Jewett's interesting sketch, in which he recalled some of his own early recollections, the changes that had been made in the spelling of the word Annisquam, and the signification of the name as being "Pleasant water," which seemed to him a beautiful designation. He recalled the experiences of his father's days when the principal part of the business of Gloucester was done in this section of the town; the building of vessels was quite extensive and his father had inspected as many as nine thousand barrels of mackerel in a single season.

Hon. N. A. Horton offered a vote of thanks to Messrs. Alpheus Hyatt and J. S. Kingsley, to Mrs. H. H. Bennett and Mrs. Alpheus Hyatt and also to Hon. Jonas H. French, for attentions and hospitalities rendered or proffered. Vote adopted.

THE ANNISQUAM LABORATORY.

BY J. S. KINGSLEY.

For several years Professor Hyatt has invited one or more students to accompany him to Annisquam to spend the summer in the study of the marine forms so abundant here. It seemed from the number of applications that there was a demand for a marine laboratory on the coast near Boston which should be practically free to all. On consultation with some of the managers, the Woman's Educational Society of Boston became interested in the project and advanced the money necessary to fit up the laboratory which you have visited to-day.

The laboratory is under the charge of the Boston Society of Natural History. It was first opened for students in June of 1881 and during that summer twenty-two students availed themselves of the privileges afforded. So successful was the laboratory during its first season that money needed for a windmill was promptly furnished by that society which is doing so much for the education of woman and which has been constant and unfaltering in its support of the laboratory. By the aid of the windmill, salt water is pumped into the building thus supplying a tank on each of the tables besides three large aquaria in the centre of the room. The object of this was to keep the specimens studied alive in confinement, a task of no small difficulty. During the second year (1882) of the laboratory, fifteen students were present and during 1883 the number was nine. During these three years the laboratory has been under the immediate charge of Mr. B. H. VanVleck, a thoroughly competent instructor.

This year the number of students has been fifteen. Dur-

ing June and July, owing to the absence of Mr. VanVleck, I have had charge of the laboratory; but about the first of August he will resume the position he has so acceptably filled in the past.

The object of the laboratory is to furnish students an opportunity to study animals and plants in the best possible manner. Some of those who come are competent to conduct original investigations and they are left to follow out any line they may choose. The majority, however, come to get a foundation and to fit themselves for teaching. We have nothing to do with species. The common question asked by students at first is what is the name of this and that form. The name is not the most important thing. What we aim to teach are the structure and development of animals and the methods of study best adapted to produce teachers and investigators. Each student, unless previously qualified, dissects a series of types of the larger forms, such as sea anemones, starfish, clams, lobsters, squid, etc. After this comes a drill in the methods of investigating the embryology of marine forms. You all know that a fish comes from an egg, but have you any idea of the way in which that small, simple object becomes converted into the highly organized cod or cunner? To trace these steps of development is the province of embryology and to-day the study of embryology is solving some of the most profound problems connected with life.

All our life here is not spent with the scalpel in hand or in gazing through the microscope. We have to collect the specimens we study. Collecting may seem an easy task but, in reality, it is one which requires experience to meet with much success. On the shores and beaches, when the tide is out, we find some forms; others may be obtained by turning over stones or by digging in the mud. Still others are found below that zone which is laid bare by the

retreating tide twice in every twenty-four hours. To obtain these forms we have recourse to the dredge, a net with an iron rim, which scrapes the floor of the ocean and brings up the treasures living there.

On the surface of the water exists a fauna far different from that found in the location already mentioned, and to collect these a surface net is employed. This is made of thin cheese cloth and is dragged along the surface; the water readily passes through the tissue but the numberless animals floating at the surface are retained in its meshes. These surface forms are mostly minute, but at the same time they are exceedingly interesting. Among the forms will be found numbers of larvæ which delight the eye of the embryologist, but the vast majority are minute crustaceans as yet all but unknown to science. The myriads of these surface swimmers are beyond all computation. The product of an hour's collecting with the surface net can only be numbered by millions.

Field Day at Asbury Grove, Hamilton, Thursday, July 31, 1884.

In the immediate vicinity of the place of meeting is Wenham swamp, which comprises a territory several miles in extent, and with its beautiful ponds and woods and its diversified scenery has long been considered one of the finest localities in this county in which to botanize. Many of our rare and choice plants have here been found; and the collection made, some sixty years since, by William Oakes and Charles Pickering, then young men,[1] have made it well known among botanists. Thither repaired many of those who came to the meeting in the first train, and under the guidance of Mr. John H. Sears were successful in their findings. It is very desirable that at an early day, some of our naturalists should make a careful exploration of this region and publish the results of their researches.

Other members of the party lingered about the grove and took notice of the many improvements that have been made within the past few years, and of the new cottages which have been erected, replacing to a great extent the old tents and cheap structures of the early days of the enterprise.

The noonday lunch was partaken of in the dining hall at the grove.

The afternoon session was held in the chapel, recently erected. It was called to order at 3 P. M., by the

[1] The one entered upon the practice of the law at Ipswich, which he soon left; the other, as a medical student in the office of Dr. A. L. Peirson at Salem.

PRESIDENT, who said: This is the third time that we have been kindly invited to hold a meeting in this beautiful grove, dedicated to Christ and to the church. The first was on July 6, 1866, and the second Aug. 12, 1877. On all these occasions we have been cordially received and heartily welcomed. This is the third field meeting of the present season: the first, at Topsfield, the geographical centre of the county; the second, at Annisquam, on the borders of the sea.

At the first the land and fresh-water animals and plants were considered; at the second the marine. The first commemorated the fiftieth anniversary of the meeting held in Topsfield on the sixteenth of April, 1834. In this connection the PRESIDENT made brief notice of some of the persons who were the first to place their names on the roll of membership: Ichabod Tucker, Daniel A. White, Andrew Nichols, Thomas Spencer, Thomas Cole, Robert Manning, William Oakes, Gardner B. Perry, John L. Russell, John C. Lee, B. H. Ives, J. M. Ives and Charles G. Page.

JAMES F. ALMY, treasurer of the Asbury Grove Corporation, extended a cordial welcome to the Institute at its third meeting at the grove. He spoke of the many natural attractions of the place, and said that while, as a summer home for hundreds of people, Asbury Grove had become very popular, the fact that it had been dedicated to the worship of God gave to it an added charm. Mr. Almy referred to the singing of the birds, the beauty of the trees and the ever-changing foliage, and the many forms of animal life, all of which offered an abundant opportunity for the study of nature which should be improved.

In closing, he gave some information regarding the growth of the Asbury Grove Association, the erection of new cottages and villas and the building of the new chapel, which was paid for by subscriptions in small sums from the people.

Mr. George D. Phippen, introduced by the President as a member who joined the Natural History Society when a very young man, and who had in various ways, covering a period of many years, promoted its objects, said that we might well draw inspiration from the double purpose for which people come here; there was no difficulty in harmonizing science and religion, both grew from a common inspiration. In this world there have been great convulsions in the building up of the earth; but the process of completion is still going on. Among the prophets of science was Darwin, and the evolutionary principle is recognized as containing the elements of truth. He then spoke of plants with special reference to man's methods of helping nature; selection, cross-breeding and hybridization were the three methods he described. He closed with an appeal to encourage the study of natural history among the young, and said that it had been of great service to him through life.

Vice President F. W. Putnam was the next speaker. He said that a little incident which occurred just before the meeting led him to take curiosity as the subject of his remarks. He then stated that while he was sitting under the trees with a friend he noticed many red ants, which were all going in one direction and all carrying objects of the same character. His curiosity was aroused and he caught several of the ants and found that each was

carrying another ant, apparently of the same species. While he and his friend were making their observations, a few other persons gathered around, and in a short time curiosity led many others to the spot and all became interested in the ants and curious to know why they were thus engaged in carrying their fellows, which it was found, could travel well enough as soon as they were taken from the jaws of their bearers. This led to a few statements in relation to the habits of the ants; and thus curiosity had led to knowledge. In this way curiosity had often been the cause, leading men to devote their lives to deep studies, the results of which had been of great importance to mankind, and when properly directed curiosity could not fail to elevate the mind; while misdirected curiosity, on the contrary, debases ourselves and often proves injurious to our fellow-men.

The speaker then gave instances in the life of some of the early naturalists who regarded all natural objects as curiosities, and who wrote to their friends to send them such curiosities as could be obtained, stating that they were curious to compare objects from different places. Thus begun many branches of natural science which have since occupied the minds of profound thinkers and men of deep research. He then called attention to the collecting of arrowheads and other worked stones, out of simple curiosity on the part of many persons, and showed how such curiosity, if not properly directed, leads to hoarding the objects as the miser does his gold, whereas if such collections were properly used and the curiosity of the collector properly directed so as to lead to research, much of interest and importance could be made from such things in relation to the early condition of man and his migrations. In concluding the speaker called attention to the importance

of taking advantage of the natural curiosity and so directing it as to lead to high results while developing the mind.

Mr. J. H. Sears spoke with special reference to the plants peculiar to Wenham swamp. This swamp runs from Danvers to Hamilton and Ipswich, a distance of about five miles, and is three miles broad. In the part in Danvers and West Wenham, where he had botanized most, are the *Trillium erectum* L., *Cypripedium parviflorum* Salisb., *Cypripedium spectabile* Swartz., *Stellaria borealis* Bigelow, *Viburnum lantanoides* Michx. On Turkey Island, at this end of the swamp, the *Cornus florida* L. grows in abundance. He made reference to many plants that had been collected during the day, describing the peculiarities of several varieties.

Rev. B. F. McDaniel made an interesting talk upon the bat and beetle, specimens of which had been given to him since his arrival. He had trained himself to keep an eye upon nature and nature's God, because he did not feel that he would be fitted to enter upon the future life, until he had learned all he could about this. Speaking of the beetle he described the details of its structure to show its adaptability to its needs. He closed by speaking of the desirability of the study of natural history in vacation days, and of this place as being adapted to such study; and also as favorable to the mental growth to be obtained in this way.

Mr. N. A. Horton made reference to the nature of the Institute as devoted to inquiry into things which pertain to civil history, as well as to those which relate to

natural history. Mr. Spencer, of whom the President had spoken, gave shelter to George Thompson, the English anti-slavery agitator, when he was in Salem. Rev. Mr. Cutler, who preached fifty years in Hamilton, took an important part in founding the first settlement in the state of Ohio, which was a part of the great northwest territory to which the ordinance of 1787 applied; and there has been a strong presentation to show that this early anti-slavery measure, of which Nathan Dane of Beverly is supposed to be the author, was a result of preliminary councils, in which Dr. Cutler was a conspicuous influence.

He spoke of the many improvements made at the grove since 1877, and of the many attractions of the place. He alluded to the courtesies extended to the members of the Institute, and concluded his remarks with proposing the following vote which was unanimously adopted.

Voted, That the thanks of the Essex Institute be extended to the officers of the Asbury Grove Association for the use of the grove and the chapel, to James F. Almy for many attentions, and to the young ladies who served so efficiently at the dinner tables.

Field Day at Newbury Old Town, Thursday, August 28, 1884.

The party, on arrival in the early morning trains, proceeded to Plum Island, and spent two hours in a pleasant ramble; thence to the Old Town Parish, where the local points of interest were visited; some to inspect the collections of Mr. Alfred Osgood, some to the old burial ground containing the graves of Rev. John Parker, the Sewalls and many of the first settlers; others to see several of the old houses, especially the residence of the late Joshua Coffin, the historian of Newbury, and the house built by Rev. James Noyes, pastor of the parish from 1635 to 1656, the year of his death, in the 48th year of his age, and now occupied by a descendant, Miss Mary E. Noyes, who was very courteous to the numerous visitors. Delegations from Groveland, Danvers and Byfield arrived at noon.

The afternoon session was held at 2.30 P. M., in the lower hall of the chapel, and was largely attended by residents as well as by the Institute party.

The meeting was called to order by the President, who spoke of another visit of the Institute to Newbury, on a beautifnl October day, twenty years ago. Some of those who were present then are present to-day; but among the absent who are still living, no one is missed more than the venerable Rev. Dr. Withington, who at that time favored the Institute with an interesting sketch of the First Church at Newbury, of which he, then at the age of seventy-five, was the active pastor. He closed by introducing

Luther Dame, of Newbury, who read a carefully prepared paper on "The Life and Times of Sir William Pepperell." He reviewed the life of the Elder William, his early struggles and the laying of that mighty fortune which made the name of Pepperell such a tower of strength in the early colonial days down to the time of Sir William, and the final extinction of the name in America.

At the outbreak of the French and English war in 1744, the appointment of the second William by Governor Shirley, to lead the expedition against Louisburg, lifted him into prominence in the colonies and gave him enduring fame. He advanced £5,000 out of his own fortune to defray the expenses of the war and gave himself energetically to the organization of the army. The speaker exhibited original correspondence and other memorials of Sir William and other leading actors in the war, which had been handed down in the family.

This paper was referred to the publication committee to be printed in the Historical Collections.

Alfred Osgood, of Newburyport, read a paper on "Archæology," illustrated by the exhibition of Indian arrowheads and other rude stone implements. His views of their uses were entirely different from those of most students; instead of thinking all these arrowheads, etc., to have been made and used for warlike purposes, he believed that many of them were of an emblematic character; some were used as drills, others for various domestic purposes, and he did not consider it unlikely that many were carried as ornaments. The arrow-chipper kept the art in his own family, and as he was never molested had ample opportunities to indulge his tastes in the way of fanciful designs. The speaker exhibited illustrations which he considered were rude attempts to represent fly-

ing birds, chosen as emblems to propitiate the powers above, and another of a stone implement described by a writer as a weapon of war, which in reality was an ingenious implement used for doubling and twisting cords in household spinning.

Hon. STEPHEN H. PHILLIPS spoke on "The Early Settlers of Newbury."

Among the early settlers of Ipswich who found their way here were the Rev. Mr. Parker, his neighbors John and Benjamin Woodbridge and the Rev. Mr. Noyes. In 1635 they came to this village and Old Town by way of the River Parker, named in honor of the distinguished divine.

He alluded to the long and bitter controversies which sprung up in the parish; he then proceeded to discuss the great witchcraft delusion of the early days and closed by describing a visit to the old home of Rev. Mr. Noyes and tracing the honorable record of the Woodbridges in other states.

The remarks of Mr. Phillips were referred to the committee on publications to be printed in the Historical Collections.

Rev. B. F. MCDANIEL, of Salem, read an elaborate paper on the "Geology and Mineralogy of Newbury," which is herewith appended.

D. B. HAGAR, of the State Normal School, Salem, presented the following resolution which was unanimously adopted:

Resolved, That the hearty thanks of the Essex Institute are hereby presented to Alfred Osgood, of Newburyport,

and Miss Mary E. Noyes, of Newbury, and their co-workers, for their earnest and efficient labors towards promoting the pleasure and success of the present meeting; to the First Parish of Newbury for the free use of its chapel; and to the several gentlemen, who, by their entertaining and instructive addresses, have largely contributed toward the important objects which are ever cherished by the Institute.

Rev. Fielder Israel, of Salem, briefly described a call upon Rev. Dr. Withington, the venerable divine, during the day, and then moved the appointment of a committee to consist of the President, Mr. Phillips and the Secretary, for the purpose of drafting a resolution to be spread upon the records, commemorative of this meeting and the appreciation on the part of the Institute of the life, learning and piety of Rev. Dr. Withington. The motion was adopted.

George Osgood, of Kensington, N. H., remembered a prayer delivered by the venerable divine, forty years ago, in the course of which he presented a sentiment, he, the speaker, had never forgotten and which he thought was applicable to-day. "Let us elect members we are not ashamed of, nor afraid to obey."

The Committee to Dr. Withington.

Rev. Leonard Withington, D. D.

My Dear Sir:

In the opening remarks at the field meeting held in Newbury on Thursday, August 28, 1884, reference was made to the meeting held here some twenty years previously, on a pleasant October day, when you made

some interesting remarks on the history of this church and society, and regrets were expressed at your absence on the present occasion.

Rev. Mr. Israel, of Salem, alluded to the pleasant call which he had made on you this morning, and proposed that the Institute tender to you its high appreciation of your faithful services, not only in your long pastorate among this people, but in the advancement of religious truths, education and general culture in the community.

This suggestion was unanimously approved by the meeting, and in conformity with the wish so feelingly expressed, the members of the Essex Institute now formally present their tribute of high regard and esteem, and officially express the veneration which is due to your advanced years and elevated character.

May Heaven still longer spare your well-spent life!

With the high respect of the Essex Institute,

Henry Wheatland, *Pres.*
Stephen H. Phillips,
George M. Whipple, *Sec'y.*

GEOLOGY AND MINERALOGY OF NEWBURY.

BY B. F. McDANIEL.

THE geology of Newbury is that of the Huronian system of the Eozoic period, that is, the period of earliest life. The rocks of this system overlie those of the Azoic period, and, until recently, were held to be non-fossiliferous. But the discovery of the Eozöon Canadense in the Laurentian limestones of Canada and here in Newbury moved far back the palæontological horizon. With the exception of small areas of palæozoic rocks in Quincy and Braintree, the Huronian system forms the main part of the coast from the New Hampshire line to Plymouth. In great part it is drift-covered.

The rocks in sight show great disturbance and metamorphism. In some localities the evidences of these changes are of the most striking character. Their condition is simply chaotic.

The stratified portions have usually a northeast by southwest strike, and the unstratified and intruded members of the series show a parallelism with the strike of the stratified rocks, which usually dip sharply to the northwest.

The Huronian system in eastern Massachusetts is chiefly made up of the following rocks:

1. Granite (hornblendic and binary).
2. Felsite (petrosilex of some authors).
3. Diorite (unstratifed and chiefly exotic).
4. Hornblendic gneiss, stratified diorite.
5. Limestone.

1. *Granite.* It will be noticed by recent students of geology that several changes have taken place in the classification of our rocks. The old name syenite has given place to that of hornblendic granite, as being more specific. The term granite is now used to cover many varieties of rock, all crystalline, ranging from distinct diorite on the one hand to felsite on the other. The specific names of these varieties are determined by the presence or absence, and the greater or less quantity, of certain constituent minerals, mainly hornblende, in the rock. I have always maintained, and this is the view now generally accepted, that there are no absolute distinctions between rocks. There are varieties almost infinite, but no absolute species. It is possible to arrange a continuous scale of specimens covering the whole series.

It is necessary to have specific names for strongly marked rocks, though these resolve themselves into varieties that shade off again into other species. It requires long familiarity with, and close study of, all classes of rocks to be able to determine these specific distinctions. When even the professors and geological authors differ so much in their classifications, amateurs need not feel cast down by an occasional mistake.

In Newbury a fine hornblendic granite is developed in two bands or ridges running east and west, enclosed by diorites, and broader and coarser at the eastern than at the western end.

The serpentinic limestone is associated with this granite, which led Dr. T. Sterry Hunt to call it Laurentian; but the whole formation is pronounced by Mr. Crosby to be Huronian.

2. *Felsite.* This term is now used to cover many varieties of rock, some of which were formerly called porphyry, metamorphic slate, hornstone, etc.

The term porphyry has deservedly fallen into disuse as a substantive, and is now rightly used as an adjective. All the varieties once called porphyry are now arranged as varieties under the several great species or families of rocks.

The term felsite is used to include rocks composed mainly of a fine paste of quartz and feldspar, sometimes enclosing grains of quartz and crystals of hornblende and feldspar, sometimes banded like jasper, and sometimes segregated like conglomerate. Examples of the compact varieties are the so-called jasper of Saugus and Lynn; the banded varieties are found at Marblehead, and an example of the segregated variety is the so-called toadstone of Newbury.

The Newbury felsite extends in a belt along the River Parker, from its mouth to Byfield, a distance of five miles. Its width is from a few rods to a mile and a half, and lies between belts of granite.

Its prevailing color is a deep red or brownish red, but sometimes shades to purple, pink and gray. It is never porphyritic, but shows a banded structure, due to the interlamination of layers of quartzose and feldspathic materials. This banding indicates a sedimentary, not an igneous origin, though like all metamorphic rocks, our felsite has undergone material change.

I have already alluded to the so-called toadstone of Newbury as a variety of felsite. A full examination of this rock will be found in Crosby's Geology of Eastern Massachusetts, which I have largely followed in this paper.

In Newbury the felsite is highly ferruginous. The sides of the granitic basin in which it lies partake of the reddish cast of the felsite. In some places it might not im-

properly be called an iron ore, and its decomposition in one or two places observed by me has yielded a red ochre.

3. *Diorite.* This rock is laid down on Crosby's map as covering a large part of Newbury. It is the gangue of the argentiferous galena. Composed of feldspar and hornblende, generally in a finely divided, and sometimes in an impalpable mixture, it is very hard.

Diorite is a convenient term to describe all that class of rocks formerly known as trap and greenstone. Like granite and felsite, it is not the name of a single distinct species, but of a family having relationship on one hand to felsite, and on the other to granite and hornblendic gneiss.

4. *Limestone.* The magnesian limestone of Newbury is the best known of its geological formations.

In colonial times quarries of it were worked at the localities known as the "Devil's Den" and "Devil's Basin." In his diary of remarkable events uuder date of 1697, Judge Sewell records the discovery by Ensign James Noyes, of the beds of limestone in this town at the localities just named. The discovery created great excitement, as hitherto clam and oyster shells had been the only sources of lime, and great difficulty had arisen in consequence.

This appears to have been the first limestone discovered in Massachusetts, and so valuable was it held to be that restrictive regulations for its use were adopted and a committee appointed by the town to enforce them.

In the first century after its discovery, quantities were exported, though from the size of the excavations I should

judge that the whole amount was not large. Why the quarry was abandoned I have not been able to learn.

It is in the "Devil's Den" that the most interesting minerals in Newbury are found. I have visited it and the other localities here for the last twelve years. First in interest is the serpentine, varying from a rich bottle green to a leek green; the first compact, pure and translucent, the second impure and opaque; the most harmful impurity being iron pyrite disseminated through the mass.

Great expectations were once entertained as to the commercial value of this rock, and a company operated the quarry for marble, but nothing has been done in a commercial way for many years. A shaft was sunk in the field, not far off, during the silver excitement, but was soon abandoned. Quantities of a beautiful porphyritic rock were thrown out, that in masses, might prove to be profitable.

At present, hardly enough attractive rock is in sight to warrant great expectations, and the large masses of wollastonite, garnet, calcite and dolomite mixed with the serpentinic limestone would seem to confirm this view; but when we consider that the excavations have not even reduced the knolls to the level of the surrounding country, and the "Den" itself is a very modest pit, the resources of the place can hardly be said to be exhausted.

I am firmly of the belief that some generous blasting would reveal an abundance of fine, rich stone, superior to any verde antique marble in our market. Associated with the serpentine are masses of wollastonite, once called tremolite. It is a beautiful white mineral, in long, bladed, radiated crystals. It is too brittle to serve any other than the mineralogist's purpose.

Masses of compact garnet are also found at the "Den." When associated with or disseminated through the ser-

pertinic limestone, this massive garnet enriches it for ornamental purposes. It is also an excellent flux, and possibly may sometimes serve that purpose here.

Small masses of crystallized calcite appear, which I believe to be the same as the chalybite or carbonite of iron that occurs in connection with the galena at the silver mines and elsewhere in Newbury.

Asbestus occurs at the "Den," but not in large quantities. Much of the mineral there found and called asbestus is an asbestiform serpentine, or chrysotile, which appears in thin seams interlaminated with noble serpentine. This is one of the most beautiful combinations known to me. The dark green serpentine prevails at the "Den," the light green at the "Basin," which is a larger excavation, but not so well known.

It would seem that information on these points would be better known here than elsewhere. Possibly this is the case with the silver mines, the popular interest in which was almost as great as was the speculative. The discovery and rapid development of the argentiferous galena was one of the great epochs in your local history. A sadly brief one it was, as these deserted mounds and works testify.

That this clean, brilliant metal, mined in masses that made the town talk of those days, and yielding flattering assays, was not to be a perpetual bonanza, was regarded as rank heresy.

At least, that was my experience. No account, apparently, was taken of the local geology nor of the character of the gangue rock with reference to its docility in smelting. I ventured to express an opinion to the superintendent of the Chipman mine that these galena deposits were pockets in the diorite, each of them comparatively small in size, though possibly many in number. Operations

were suspended sooner than I anticipated, judging from the output of the leading mine, so that I do not know whether this theory was or was not confirmed. It is to be hoped that a part of the expectations then raised may sometime be realized.

The last formation to be noticed is the amygdaloid lying in the basin of the River Parker and on Kent's Island. This is a purplish-brown or chocolate color. It is not of great extent and is of little importance. On one side it passes into a breccia, and on the other into a chlorite slate, and may be only a product of the felsite.

I trust I have said enough to show that Newbury is rich in geological and mineralogical interest, and to excite a desire in some minds to explore still farther these fields and hills. It was amateur exploration that revealed these minerals of which I have been speaking. It is to the amateur geologist that the professional student mainly looks for hints.

Where so many richly suggestive hints exist as in Newbury, the amateur ought to feel encouraged to prosecute his field-work; not, let me say, in the hope of "striking something rich," with which to form a stock company, but to contribute new and important facts to science and to enrich his own mind with the wealth of knowledge and beauty that fills the earth.

FLOWERING OF PLANTS, DECEMBER, 1884.

At the meeting of the Institute, held on Monday, December 15, 1884, Mr. John H. Sears presented the following list of plants which he had found in bloom in the fields and pastures of Salem and vicinity.

DEC. 8, 1884.

Tansy, *Tanacetum vulgare.*
Fall Dandelion, *Leontodon autumnale.*
Common Dandelion, *Taraxacum Dens-leonis.*
Golden Rod, *Solidago nemoralis.*
Sea-side Golden Rod, *Solidago sempervirens.*
Shepherd's Purse, *Capsilla Bursa-pastoris.*
Charlock, *Brassica sinapistrum.*
Field Chickweed, *Cerastium arvense.*
Common Mallow, *Malva rotundifolia.*
Yarrow, *Achillea millefolium.*
Common Groundsel, *Senecia vulgaris.*
Red Clover, *Trifolium pratense.*
Mayweed, *Maruta cotula.*
Arrow-leaved Violet, *Viola sagittata.*
Spurry, *Spurgula arvensis.*
Knawel Weed, *Scleranthus annuus.*

DEC. 14, 1884.

Witch hazel, *Hamamelis Virginica.*

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BULLETIN

OF THE

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HUGO RIED'S ACCOUNT OF THE INDIANS OF LOS ANGELES CO., CALIFORNIA.[1]

WITH NOTES

BY W. J. HOFFMAN, M. D.

THE following epistles were copied by the writer during the summer of the present year, 1884, from the original MSS. in possession of the Hon. A. F. Coronel, of Los Angeles, Cal., to whom they were written in the year 1852 by the late Hugo Ried from the San Gabriel Mission where the author lived at that time. These epistles were intended as a contribution to "A History of the Indians of Los Angeles Co.," but of the original thirty-two only twelve refer to the subject in detail, the remainder consisting of information relating to the establishment, and decline, of the Franciscan Missions in California, facts with which we are already familiar through other sources.

Some of the epistles are variously signed "Hugo Ried," and "P. Hugo Ried," though the writer could not ascertain which was correct. The author, so Mr. Coronel states, was a Scotchman of considerable intelligence, who, after meeting with disappointment in an *affaire de cœur* in Sonora, came to the San Gabriel Mission, married an Indian woman of the tribe located there, and remained,

literally cut off from the outside world until the day of his death.

With the exception of a few preliminary remarks, not germane to the subject under consideration, the epistles are given *verbatim et literatim.* Unless otherwise stated, the pronunciation of words, and letters, is in accordance with the Spanish language. The superior figures (as [2]) in the text refer to the notes at the end of this article. The writer is responsible for all remarks in brackets.

LETTER I.

The following are the rancherias with the corresponding present names :

Yang-na	Los Angeles
Sibag-na	San Gabriel
Isanthcog-na	Mision Vieja
Sisit canog-na	Pear Orchard
Sonag-na	Mr. White's Place
Acurag-na	The Presa
Azucsag-na	Azuza
Cucomog-na	Cucamonga
Pasinog-na	Rancho del Chino
Pimocag-na	Rancho de Ybarra
Awiz-na	La Puenta
Chokishg-na	Iaboneria
Pimug-na	Island of Santa Catalina
Toybipet	San José
Hutucg-na	Santa Ana (Yorbas)
Almpquig-na	Santa Anita
Maug-na	Rancho Felis
Hahamog-na	Rancho Verdugos
Cabueg-na	Cabuenga
Pasecg-na	San Fernando
Suang-na	Suanga
Pubug-na	Alamitos
Tibahag-na	Serritos
Chowig-na	Palos Verdes
Nacaug-na	Carpenter's farm
Kinkipar	Island of San Clemente

Irup and San Bernardino, etc., belonged to another distinct tribe possessing a language not at all understood by the above lodges, and although reduced by the Spanish Missionaries to the same labor and religion, they never amalgamated their blood, they being considered as much inferior, and named *Serranos* or Mountaineers.

The captains or chiefs of each lodge took its name followed by *ic*, with sometimes the alteration of one or more final letters. For instance, the chief of Azucsagna was called *Azucsavic;* that of Sibagna, *Sibapic.*

The title of a chief's eldest son was *Tomeár;* of his eldest daughter, *Manísar.*

Suanga was the most populous village.

The Cahuillas were named by the Spanish missionaries; thus misnamed as a tribal name, the word *cahuilla* signifying *master.*

LETTER II.

They have a great many liquid sounds and their gutturals are even softened down as to become agreeable to the ear. In the following examples *i* has the sound of *ee;* *u* of *oo;* *e* of *a* as in fare; *a* of *a* as in father; *ay* of *i;* *gn* as in French.

Numerals.[2]

1 Pucu
2 Wehe
3 Pahe
4 Watzu
5 Mahar
6 Babahe
7 Watza caviá
8 Wehez watza
9 Mahar caviá
10 Wehez mahar
11 Wehez mahar coy pucu [coy-*and*]
12 Wehez mahar coy wehe

20 Wehez wehez maghar [*g* and *h* combined][3]	
30 Pahez wehez maghar	
40 Watzahez wehez maghar	
50 Mahares wehez maghar	
100 Wehez wehez mahares wehez mahar	
Once	Pucushe
Twice	Wehez
Three times	Pahez
Four times	Watzahez
Five times	Maharez
Ten times	Wehez maharez
There is / There are	Woni
There is none / There are none	Yahez
Yes	Ehez
No	Hay
Presently	Wake
Before	Aunuco
To-day	Mitema
Yesterday	Poana
To-morrow	Yamte
Here	Ycuaro
There	Muro
Far off	Poane
I	Noma
Thou	Oma
He or she	Mané
Man	Woroyt
Woman	Tocor
Boy	Quité
Black	Yupiha
White	Arawatay
Red	Quaoha
Blue	Sacasca
Yellow	Payuhuwi
Green	Tacape
Sun	Tamit
Moon	Moar
Stars [*sic*]	Zoot
Dog	Wozi
Coyote	Ytur
Bear	Hunar
Deer	Zacat

To hear,— Nahacua.

1.	Nonim nahacua,	I hear.
2.	O-a nahacua,	Thou hearest.
3.	Mané nahacua,	He or she hears.
1.	Non him nahacua,	I heard.
2.	O-a him nahacua,	Thou heardest.
3.	Mane him nahacua,	He or she heard.
1.	Nop nom nahacua,	I shall hear.
2.	O-pam nahacua,	Thou shalt hear.
3.	Mane-pom nahacua,	He or she shall hear.

To speak,— Sirauaj.

1.	Non-im sirauaj,	I speak.
2.	O-a sirauaj,	Thou speakest.
3.	Mane sirauaj,	He or she speaks.
1.	Non him sirauaj,	I spoke.
2.	O-a him sirauaj,	Thou spokest.
3.	Mane him sirauaj,	He or she spoke.
1.	Nop nom sirauaj,	I shall speak.
2.	O-pam sirauaj,	Thou shalt speak.
3.	Mane pom sirauaj,	He or she shall speak.

They have no word to express *love*, but terms as *to have affection for* or *to regard.* The nearest approach to express the idea of love is *uisminoc.*

[Present tense.]

Sing.
1. Nonim uisminoc.
2. O-a uisminoc.
3. Mané uisminoc.

[Past tense.]

1. Non him uisminoc.
2. O-a him uisminoc.
3. Mane him uisminoc.

[Future tense.]

1. No que im uisminoc.
2. O-que-a uisminoc.
3. Mane que uisminoc.

LETTER III.

The Santa Inéz tongue is understood by the Indians of the Purissima, Santa Barbara[4] and San Buenaventura, with this difference, that the two latter splutter their words a little more, which almost seems impossible! The *l* is used in this tongue, although not in the Gabrielino, which is strange. The only word in the Gabriel tongue which has an *l* is an interjection, *alala*, equal to Oho! The Serranos have no *l* either, in use, and their language is as easy as that of San Gabriel.

The Serranos generally employ a *t*, when the Gabrielinos would use an *r*.

LETTER IV.

Gabrielino.

Father, mother, husband, son, daughter, face, hair, ear, tongue, mouth and friend, are words never used without a personal pronoun, as:

Father, *nack*, my father, *ni nack*, thy father, *mo nack*, his or her father, *a nack*.

Husband and wife. If they have had children, instead of saying *ni asum*, my husband, they often say *ni táliaisum*, which may be translated *part of my body*.

All brothers older than the speaker are styled *apa; ni apa*, my brother; all younger, by *apeitz; ni apeitz*, my younger brother. They have no word to express Indian. Tahat signifies people. The whites are termed *chichinabro*, reasonable beings.

Face and eyes are expressed by the same word.

Ear, *nanah;* the leaves of a tree are called its ears.

Snow and ice are the same.[5]

Tobagnar, the whole earth; *lahur*, a portion of it, a piece of land.

Caller, forest. No word to signify tree, all varieties have their special names.

Cabatcho, good looking.

Zizu, devil, an evil spirit.

Ayopu-cushna, brother-in-law.

Qua-o-ar, God. Held in great reverence, and the name was seldom pronounced among them. They generally used the term, *Y-yo-ha-riv-gnina*, that which gives us life.

LETTER V.

Government, Laws and Punishment.

The government of the people was in the hands of the chiefs, each captain commanding his own lodge. The command was hereditary in a family, descending from father to son, and from brother to brother. If the right line of descent ran out, they immediately elected one of the same kin nearest in blood. Laws in general were made as they were required, with the exception of some few standing ones. Robbery and thieving were unknown among them, and murder, which was of rare occurrence, was punished by shooting the delinquent with arrows until dead. Incest was held in deep abhorrence and punished with death; even marriages between kinsfolk were not allowed. The manner of death was by shooting with arrows.

All prisoners of war were invariably put to death, after being tormented in a most cruel manner. This was done in presence of all the chiefs, for as war was declared and conducted by a council of the whole, so they had to attend to the execution of enemies in common. A war dance, on such an occasion, was therefore grand, solemn and maddening.[6]

If a quarrel ensued between two parties the chiefs of

the lodge took cognizance in the case and decided according to the testimony produced. But if a quarrel resulted between parties of distant lodges, each chief heard the witnesses produced by his own people, and then in council with the chiefs of the opposite side they passed sentence. Should they disagree, another chief, impartial, was called in who heard the statements made by the two captains, and he decided alone. There was no appeal from his decision. Whipping was never resorted to as a punishment, restitution being invariably made for damages sustained, in money, food and skins.

If a woman proved unfaithful to her husband and he caught her in the act, he had a right to put her to death, if he chose, without any interference by any of the tribe. But what was more generally practised, he informed the paramour he was at liberty to keep her, and then he took possession of the other's spouse. The exchange was admitted as legal by all concerned, and the paramour would not object.

Although they counted by moons, still they had another mode for long periods, which was to reckon from the time the sun was farthest north, till he was at his southern extremity, and then back again. Summer was counted from the time frogs were first heard to croak. This was used to count war scrapes by, and under the recollection of the chief. When other tribes had to be chastised, the chief sent an express to all other lodges. They brought up from children a number of males, who were taught to hear long stories by the chief and to repeat them word for word. In this manner they became so perfect as to be able to recite the longest oration any one could produce.

They were not much given to travel, for they only relate of *one* who left his people and proceeded north till he

came to the land where the geese breed. And even he appears to have possessed that property ascribed to his race, for on his return he informed them of having fallen in with people whose ears reached down to the hips; others of a small stature; and finally a people so perfect that they would lay hold of a rabbit or other animal, put it near the mouth, draw a long breath and then throw the rest away; which on examination was nothing but excrement! They sucked with their breath the essence of the food and so lived without any calls of nature.

LETTER VI.

Food and Raiment.

The animal food used by the Gabrielinos consisted of deer meat, young coyotes, squirrels, badgers, rats, gophers, skunks, raccoons, wild cats, the small crow, blackbirds and hawks, and snakes, with the exception of the rattlesnake. A few eat of the bear, but in general it was rejected on superstitious grounds. The large locust or grasshopper was a favorite morsel, roasted on a stick at the fire. Fish, whales, seals, sea-otter and shell-fish formed the principal subsistence of the immediate coast range lodges and Islanders. Acorns, after being divested of the shell, were dried and pounded in stone mortars, put into filterers of willow twigs worked into a conical form and raised on little sand mounds, which were lined inside with two inches of sand; water added and mixed up; filled up again and again with more water, at first hot, then cold, until all the bitter principle was extracted; the residue was then collected and washed free of any sandy particles it might contain; on settling, the water was poured off; on being well boiled it became a sort of mush, and was eaten when cold. The next favorite food was the kernel of a species of plum which grows in the

mountains and islands. It is sometimes called the mountain cherry, although it partook little of either, having a large stone wrapped in fibre and possessing little pulp. This, cooked, formed a very nutritious, rich, sweet aliment and looked much like dry frijoles. *Chia*, which is a small, gray, oblong seed, was procured from a plant apparently of the thistle kind, having a number of seed vessels on a straight stalk, one above the other like sage. This roasted and ground made a meal which was eaten, mixed with cold water, being of a glutinous consistence and very cooling. Pepper seeds were also much used, likewise the tender tops of wild sage. Salt was used sparingly, as they considered it having a tendency to turn the hair *gray*. All of their food was eaten cold or nearly so.

The men wore no clothing; the women of the interior wore a short waist skirt of deer-skin, while those of the coast had otter-skin. Covering for sleeping consisted of rabbit-skin quilts.[7] The women wore ear-rings, the men passing a piece of cane or reed through the ear lobe. The ear-rings of the women were composed of four long pieces of whale's tooth ground smooth and round, about eight inches in length, and hung, with hawks' feathers, from a ring of abalone shell. Their necklaces were very large and heavy, and consisted of their money beads, of beads made of black stone[8] and pieces of whales' teeth, ground round and pierced. They used bracelets of very small shell beads on both wrists.

LETTER VII.

Marriages.

Chiefs or captains had one, two, or three wives, as their inclinations dictated. Their subjects only one. When a person wished to marry, and had selected a suit-

able partner, he advertised the same to his relations. On the day appointed, the male portion of the lodge and male relations living at other lodges, brought in their contributions of shell-bead money, generally to the value of twenty-five cents each. The contribution ready, they proceeded in a body to the residence of the bride where all of her relations were assembled. The money was then divided equally among them, the bride receiving nothing, as it was a purchase. After a few days, the bride's female relations returned the compliment in taking to the bridegroom's dwelling baskets of meal made of Chia, which was distributed among his male relations. These preliminaries over, a day was fixed for the ceremony, which consisted in decking out the bride with innumerable strings of beads, paint and skins. Being ready, she was taken up in the arms of one of the strongest of the tribe who carried her, dancing, towards her sweetheart's habitation, all her family connections dancing around and throwing food and edible seeds at her feet at every step, which were collected by the spectators as best they could in a scramble. The relations of the groom came and met them, taking away the bride from the carrier and doing the duty themselves, as likewise joining in the ceremonious walking dance. On arriving at the bridegroom's lodge, who was within waiting, the bride was inducted into her new residence, placed beside her husband, and baskets of seeds emptied on them to denote blessing and plenty. These were likewise scrambled for by the spectators, who, in gathering up all of the "seed cake," departed, leaving them to enjoy their honeymoon according to usage. The bride never visited her relations from that day forth, but was at liberty to receive their visits.

Should the husband beat the wife and ill-treat her, she gave advice of it to her lodge, when her relations col-

lected all the money which had been paid at her marriage, took it in deputation to the husband's lodge, left it with him and led off the wife, whom they married immediately to another.

LETTER VIII.

Birth and Burial.

Immediately on the birth of a child, the mother and infant were purified, in the following manner: In the centre of a hut a large hole was dug, and an immense fire was kindled in which large stones were heated until red-hot. When nothing remained but hot embers and the stones, bundles of wild tansy were heaped on the same and covered all over with earth, with the exception of a small chimney or aperture. The mother had then to stand over the aperture with her child wrapped up in a mat, flannel fashion; water was then poured by degrees in at the opening which caused immense quantities of steam or vapor, causing the patient to hop and skip a little at first and provoked profuse perspiration afterwards. When no more steam was procurable, the mother and child lay down on the heap, covered up, until the steaming was renewed again. Three days was the term of purification, morning and evening being the times of sweating. No food was allowed the mother during that time, and her drink (water) was warmed. She was now allowed to eat of everything at discretion, with the exception of animal food, which was debarred her for two months. Her diet at length complete, three pills were prepared of the size of a musket ball composed of one part of meat and one part of wild tobacco. These swallowed, she was allowed to eat meat; but she was not permitted to share her husband's bed until the child was able to run.

When a person died all the kin collected to lament and mourn his or her loss. Each one had his own peculiar mode of crying or howling, and one could be as easily distinguished from the other, as one song from another. After lamenting awhile, a mourning dirge was sung in a very low tone, accompanied by a shrill whistling by blowing into deers' bones. Dancing can hardly be said to have formed a part of their rites, as it was merely a monotonous action of the foot by stamping on the ground. This was continued until the body showed signs of decay, when it was wrapped up in its covering with the hands across the breasts and tied from head to foot. A grave having been dug in their burial place, the body was interred according to the means of the family, by throwing in seeds, etc.[9] If deceased was the head of a family, or a favorite son, the hut was set fire to, in which he died, and all of his goods and chattels burned with it, reserving only some article with which to make a feast at the end of twelve months.

LETTER IX.

Medicine and Diseases.

Medicine men[10] were esteemed as wizards and seers, for they not only cured disease, but caused disease and poisoned people; made it rain when required; consulted the Great Spirit and received answers; changed themselves into the form of diverse animals, and foretold coming events.

The medicine man collected the poison used for dipping the heads of arrows. Fire was supposed to destroy its hurtful properties, consequently the flesh of animals so killed were eaten without any misgivings. The Seers pretended not only to know poisons which destroyed life by giving it internally, but also others which the simple

touch was sufficient to produce the desired effect; and that some were instantaneous, and that others required one, two, or even twelve months before action took effect.

Rheumatism comprised nearly all the general complaints. Syphilis[11] was unknown. Toothache seldom troubled them. Rheumatism was treated by applying a string of blisters, each the size of a dime, to the affected part. The fur off the dry stalks of nettles was used for blistering; this was rolled up, compressed, and applied with saliva; then fire was applied, when it burned like punk; as one was extinguished, another was lit. For lumbago, they drank of a sweating herb and lay down for twenty or thirty hours in hot ashes. Fever was treated by giving a large bolus of wild tobacco mixed with lime (of shells), causing vomiting, besides other herbs and manipulations of the Seer.

Local inflammation was scarified with pieces of sharp flint and procuring as much blood as possible from the part. Paralysis, stagnation of the blood, etc., was treated by whipping the part or limb, with bunches of nettles for an hour or two, likewise drinking the juice of thorn apple which caused ebriety for two or three days. Decline (of rare occurrence) was treated by giving the cooked meat of the mud turtle for a period of time.

Shell lime was well known, but none made from limestone. For an emetic, it was mixed with wild tobacco and taken immediately in bolus, but in a more agreeable form it was pounded up and formed into a cake, and used in fragments as required.

Strangury was treated by sweating, as in the lying-in woman, only marsh mallows were employed instead of tansy; then a large bolus of chewed tobacco produced general laxation and prostration which often produced relief at once. If this failed, drawing blood by sucking

the abdomen immediately above the bladder hardly ever failed to give relief. This operation was performed with a great many rites, prior to the suction, such as smoking to the Great Spirit, pressure and frotation [*sic*] of the abdomen with the hands, and a song at the end of every verse concluded with the words

Non im mainoc, ni mainoc,
Non im mainoc, ni mainoc,
Yobare!

"I do, what I am doing,
I do, what I am doing,
Oh Church!"

Bites of snakes were cured by the application of ashes and herbs to the wound, and herbs and ashes and the fine dust found at the bottom of ants' nests given internally.

Red clay was sometimes applied to the hair, covering it all over, and allowing it to remain for twenty-four hours when it was washed off, to prevent the hair from splitting.

Chilicotes were burnt to charcoal and applied morning and evening to cure baldness.

LETTER X.

Tradition.

There were *seven brothers* who married *seven sisters* — according to their respective ages — who lived in a large hut together. The husbands went daily to hunt rabbits, and the wives to gather flag-roots, for food. The husbands invariably returned first, and on the wives' arrival reported always bad luck in hunting, with the exception of the youngest brother who invariably handed his wife a rabbit. Consequently the poor women fared badly in regard to animal food. This continued as a daily occurrence for a length of time, until in a conference held by

the women they expressed a conviction of being cheated by their husbands, declaring it strange that with the sole exception of the youngest husband, nothing was ever killed. At the same time to find out the truth, they agreed that the youngest should remain at home the following day under pretence of toothache and watch the return of the party. Next day the men as usual took their bows and arrows and set forth. The six sisters then departed, leaving the other hidden among flags and rushes at the back of the house, in such a position as to command a view of everything transacted within. Several hours before sunset the hunting party returned laden with rabbits, which they commenced roasting and eating, with the exception of one which the youngest put apart. The others called him a fool, telling him to eat the rabbit, which, however, he refused to do, saying he esteemed his wife a little and always intended to reserve one for her. "More fool you," said the others, "we care more for ourselves than for them." The feast concluded, the bones were carefully gathered together and concealed in a suitable place outside. After some time, the youngest wife arose and presented herself in the hut, to the surprise of the males, who asked her where she came from? "I have been asleep at the back of the house," answered she, "and I have only this minute awoke, having had to remain behind from toothache." After a while the women came home, who ran to their sister asking for her health. They soon found an opportunity to leave the hut and learn the results of the espionage, besides visiting the place where the bones were deposited. They cried very much and talked over what they should do. "Let us turn to water," said the eldest. This was objected to by all the rest, saying that their husbands would then drink them, which would never do. The second proposed that they

should turn into stones, which was likewise rejected, because they would be trod upon. The third wanted them to turn into trees; rejected, as their husbands would use them for firewood; and so on until it came to the turn of the youngest, who proposed they should change themselves into stars; an objection was made on the ground that their husbands would always see them, which was at length overruled from the circumstance of being out of reach. They accordingly went to the lagoon where they procured flagroots, and making an engine (flying concern) out of reeds, they ascended to the sky and located themselves as the seven stars.

Only the youngest brother appeared to be vexed at the loss of his wife, and sought her daily. One day, having wandered to the edge of the lagoon, his wife had compassion on him and spoke, directing his attention to the machine they had made, telling him to ascend. He did so, but not wishing him in their immediate vicinity, he was placed a little way off.

A song survives, having reference to the *seven stars.*

LETTER XI.

Sports and Games.

Few games, and of a gambling nature. The principal one was called *churchúrki* (or peon, Spanish). It consists in guessing in which hand a small piece of stick was held concealed, by one of the four persons who composed a side who sat opposite to each other. They had their singers who were paid by the victorious party at the end of the game. Fifteen pieces of stick were laid on each side, as counters, and a person named as umpire, who, besides keeping account, settled the debts and prevented cheating, and held the stakes. Each person had two pieces of wood, one black and one white. The white

alone counted, the black being to prevent fraud, as they had to change and show one in each hand. The arms were crossed and the hands hidden in the lap; they kept changing the pieces from one hand to the other. Should they fail to guess right, he lost his peon, and counters allotted to the others, and so on until the counters were gone, or all the peons killed, when the others had a trial. They bet almost everything they possess. The umpire provided the fine and was paid by the night.

Another game called *charcharake* was played between two, each taking a turn to throw with the points down eight pieces of split reed, eight or ten inches long and black one side.

Another game, called *hararicuar*, consisted in throwing rods or canes of the length of a lance, at a ring put in motion, and see who could insert it. The ring was made of buckskin with a twig of willow inside, and four inches in diameter. This is not played now.[12]

Football was played by children and by those swift of foot. Betting was indulged in by the spectators.

LETTER XII.

Legend.

In Muhuvit,[13] which lies behind the hills of San Fernando, a woman married a captain of Verdugas. The woman was very stingy and selfish, and when the people brought them roasted rabbit, she devoured it alone and never invited any one to eat with her. The young chiefs would surround her, but she never invited any of them. They returned to their houses, and when their mothers inquired if they had partaken of the feast, said no. Then the people got angry about it, and asked the husband to send her home again to her mother. She, by this time, had a daughter. Old men spoke with him;

do what you like, said the husband. The old men accordingly ordered the people to hunt rabbits as usual, but to stuff them, before roasting, with pieces of wet buckskin, lizards, and other unpalatable reptiles. They did so before giving the repast. The old man asked of the chief, what was to be done with the daughter, whether to take her away or not? "Leave her," said he, "to die with her mother." This day, however, she invited her spectators, for on taking out the leg of a toad, she inquired what it was? "It is a quail," she was answered. "Eat it thou, then," said she, and so she proceeded, taking out strange substances and giving them away. An order was likewise given to refuse her water, and being very lazy, it was presumed she would not go to the spring. The repast gave her great thirst. "Give me water!" but none was procurable. She proceeded from hut to hut, with like success, until she arrived at the last, where a large basket of urine was prepared for her; she nearly finished it at three sups, only leaving a little for her daughter. This occurred every day; at the end of ten days, all her hair fell out, and from being very pretty, she became old and wrinkled. Seeing herself in such a state, she determined to return to her father, and taking her daughter in her arms, she left; but on the road, she repented, having taken her daughter, and said, "What a fool I am to be carrying this load, as if they liked me so much." So she threw it away. After going some little distance she looked back and seeing the little infant stretch out its little arms to her, her heart softened, and she exclaimed, "What fault has it committed?" she turned back and took it up again. She went on and on until she got so weak she could go no farther; at last she was at a great rock, when she took the child by the heels and dashed its brains out, the blood of which is still visible at this day.

Many affirm the child did not die but turned into a squirrel.

Then the mother went on alone until she came to the place where her mother usually kept her seeds and acorns, and lay down with the *Charnuca.* At length her mother came to take out food, and on putting in her hand gave a loud cry and jumped back. "Yes, be afraid of me," said the daughter, "after all the injury you have heaped on me by marrying me to a man who did not care for me." The mother then heard the story, and left to inform the father, taking him out of the hut so no one might hear it.

The father proceeded with his wife to take food to their daughter, and every day they brought her the same, and herbs to drink so as to restore her to health and purge her of the filth she had eaten; also to restore her hair and eyebrows, which she had lost, they applied the fat or oil of the *hamisar*, a black berry. In three moons she was well again, fat, young and beautiful, hair nearly equal to her father's and brother's, which reached to the ground. She was commanded then by her father, to go and bathe herself daily in her brother's bathing place. She did so, and the brother from seeing the water when he came, not limpid as usual, suspected something. At last coming one day, shortly after the other had done, he was convinced, and more so on finding a hair half the length of his own. This troubled him much, that others were bathing in his well, and he became sad. At last, arriving one day, he caught her in the bath, and saying, "so it is you who daily dirty the water of my well," caught her by the leg and threw her out; she fell back and he beheld her nakedness. This caused her so great grief and shame, that she left and proceeded to the seashore to drown herself. She made a run twice to throw herself into the sea but each

time turned back, but the third [*sic*] time accomplished it.

The brother returned to the house and told his mother of having found an unknown woman in his bath and threw her out of it and saw her nakedness. The father and mother left the hut together, and on seeking their daughter could not find her. "She has gone from shame," said the mother; "Where shall we find her?" The father took the twig of a willow, made a ring of it, and covered it with buckskin; this was thrown to the north, it returned again; he threw it to the south, and the same result; he then threw it east; then west, the ring following all the turnings and windings of the daughter. The father followed the ring until it came to the seashore. "She has drowned herself," said he, when he saw the ring enter the ocean. He returned, debating with himself whether it was better to punish his son first, or the chief of Verdugas; he determined on the former first. On arriving home he told his wife who cried bitterly, which amazed the people much. Calling together all of his people, he told them they must take his son with them on a hunting excursion and let him be killed by wild beasts. His son was accordingly decked out in all his ornaments and money beads and told to go with the people hunting, when they were to stay out all night. He went, and they slept out, and the next morning a fire was kindled at which all were warming themselves. One of the old Seers had brought a screech owl with him, hidden, which was no other than the father of the boy, which he let out and frightened all the people who ran off leaving the boy alone, when a large bird, the *Cuwot* (cry *cu*, nothing of which, save its shadow, had ever been seen), said to be the boy's father in another form, came and took him up. Then the people came back crying, "the *Cuwot* has carried off the chief's son." As they came up, the bones came

tumbling down from above. The bones were then buried and the people returned to their huts.

Shortly afterwards, the chief saw some one coming and went to meet him; "Where are you going, where are you from?" "From Verduga." "Oh!" said the chief, "How are you getting on there?" "Very well, the chief is getting another wife, and a great feast is preparing." "Be it so," said he, "they have laughed much at me, now *we* shall laugh and all perish together. What were they doing when you left this morning?" "The women had all gone to gather prickly pears." Hearing this, he went to where the women were gathered, and said, "What are you gathering so many prickly pears for?" "For the feast," said they, "as the captain is to be married." "Take a sieve," said he to an old woman, "and fill it with tuñas[14] and sift the fine thorns into my eyes." She refused; he insisted and the others told her to do as commanded. He opened his eyes wide and she commenced, when all of the women set up a wail at once. They were blind. He burst out laughing and said, "Now I laugh, it is my turn now." He left them and went to where the feast was prepared, and going round to the west side changed himself into a huge eagle and went, low down, to where the feast was. On seeing an eagle come, they cried out, "Catch it, catch it!" with the exception of an old woman who was taking care of her grandchildren during her daughter's absence, who immediately covered the children with a blanket, and cried out to the people not to touch the eagle, as it was a human being and not a bird. The people only called her an old liar, and proceeded to catch it, which they did. "Let us pull its wings off," said they, and they did so. Blood gushed out from one side and green matter from the other. Fever and bilious vomiting commenced among them, and killed

all of the people but the old woman and her two grandchildren. The old woman had to bury the dead the best way she could and to burn the things. The eagle soared up above and never more was heard of.

The old woman brought up the young ones, and when old enough, she constructed a bow with arrow for the boy, and a batea for the girl, teaching the one how to shoot and the other to clean seed. The boy, at last, killed first a lizard, then a mouse, then a gopher. When old enough she married them, but shortly after the girl turned out bad; at first she gave the old woman to eat, but afterwards she refused to give her any meat brought by the husband. The old woman, to be revenged, took an awl made of deer's bone and placing it where the other sat, she hurt herself; she put it into the bath, and again hurt herself. When her husband came home she acquainted him, saying, "I have had injury done me twice, and know I have to die; at any time you are out in the hills and I die, you will know it by feeling some drops of water falling on your left shoulder." Not long after, when out hunting, he felt the drops as he had been told he would. He threw the bow and arrows away and hastened home. In the meantime the old woman had burned and buried the body. "Where is my wife?" "I have buried her." "Thou hast done this and shalt die for it;" taking up a billet of wood to knock her brains out, when she changed into a gopher and hid in the ground. The husband remained three days and nights by his wife's grave. On the third day he saw a small whirlwind arise which soon gave out, then another a little larger, and a third, still larger, came out of the grave, and he arose and followed it. After going a long distance he perceived footprints on the ground where it passed over. "This is my wife's," said he, and he followed an immense distance, and a voice from

the whirlwind addressed him and said, "Return to your hut." "No," said he, "I intend going with thee forward." "That cannot be," said the spirit, "for I am not as formerly. I am dead to the world, and you cannot go, for no human being can go where I am going, nor can earthly eyes behold our figures; therefore return." He would not. "Well," said the voice, "how can I take thee, there is an immense sea to pass." At last finding him positive, she bound him to her waist with her sash, telling him to hold his breath as they went through the air. They arrived at last in the land of spirits where he could see nothing like human forms, and only heard innumerable voices, exclaiming, "What a stench of something earthly, you must have brought that." The wife acknowledged she had, but exculpated herself on the ground that the being she brought was a superior one, being not only a great hunter, but could do anything. "Return him to the earth again, take him away," exclaimed the voices. But one voice at length said, "Let us try him first and see what he can do." He was ordered to climb a pole of great length, and bring down a feather from the top. He felt afraid to ascend, but his wife told him to try, but not to look down while doing so. He accomplished the feat and there was great applause, when the voices cried out *ayopui-cushna* — our brother-in-law — is good at climbing. He was then given a long hair and told to split it from end to end. This again made his courage fail, but his wife told him to do it and to have faith. He had faith in her word and the hair split from end to end with ease. "Well done, our brother-in-law," exclaimed the voices. He was told to make a map of the constellation of Ursus Major and show the position of the North star. He felt great fear to attempt this as he had seen the Seers do this but had never learned it himself. His

wife again aided him and he came out triumphant. They then wanted to test his hunting powers, and four of them were dispatched to drive the deer into his range. He soon heard loud cries of "Brother-in-law, there go the deer," but no deer could he see. The spirits ridiculed his hunting. Another trial was made with the same result. At last his wife told him he would be given a third trial and that he must kill this time. "How can I kill deer if there be none," he said. "Did you not perceive black beetles?" said his wife. "Yes." "Well, those are deer; things are different here to what they are on earth, kill them." They went on their third hunt, and hearing the cry of "There they go," he saw black beetles coming on the sands. He drew his bow, shot at, and killed one; it was converted immediately into a fine, fat buck; this encouraged him, and he slew right and left, until the spirits told him to desist. The game was carried home, he saw the deer lifted from the ground and carried in the air, though he could not see the carriers, although he could perceive their shadows. Great joy was manifested by all at his success. "Sister," said the other spirits to his wife, "no one has ever been permitted to return to earth, as thou knowest, but as our brother-in-law is so good and he cannot participate in our company of those joys and pleasures we partake, and on account of the gross materials of which he is formed, out of compassion to him, return again to earth." And addressing him they said, "Brother-in-law, return again to the earth with thy wife, but for three days thou art not permitted to cohabit with her, after that time thou art free, but a non-compliance will be attended with disappointment." They left the spirit realms and travelled on earth towards their home, the wife still invisible. At night he built a large fire and lay down; on awakening before daylight he saw

his wife lying at a short distance. They travelled the second day as before and at night he again made a fire; on awakening he again beheld her, and although he had rebellious thoughts, still he restrained himself, for he thought that only one day more and he should triumph. The third day also passed in travel and on awakening that night he saw his wife more distinctly than ever; love for her was this time more powerful than reason; the three days are assuredly expired by this time, and he crept towards her. He laid hold of the figure and found an old rotten trunk of a tree in his arms. He remained a sorrowful wanderer on earth till his death.

Whenever this legend was to be told, the hearers first bathed and washed themselves, then came to listen.

The bird Cuwot is still believed in. It is nocturnal in its habits, never seen, but sometimes heard. Its cry was simply Cu. It is said that a man was once carried away by it from the Lodge of Yan (Los Angeles).

Some state that the return of the woman to life after the soul had fled, could not have happened. It being only a compassionate ruse to get the husband back to earth, to return again at a proper time in the form of a celestial being.

NOTES.

1. Refers in particular to the sub-tribe located in the vicinity of San Gabriel, usually termed Tobikhar, and known as the Kizh of former investigators. The subdivisions of the Kauvuya tribe are only recognized on account of dialectic differences. The tribe is one of the group composing the Shoshonian linguistic family, and formerly extended from the coast to the Colorado river, and from near San Diego, northward to the San Fernando mountains. Later, the tribe was divided into the *Serranos*, or mountaineers and *Playsanos*, or lowlanders. Of the latter are the Tobikhar.

The language is still spoken by a number of people, notwithstanding statements made to the contrary. The words Cahuilla and Coahuilla should be abandoned, as they are liable to cause confusion with a similar name, of a distinct stock, in Mexico. The word Verdugos also occurs as Verdugas, in Letter XII.

2. The herds of cattle and horses owned by the Missions were grazed in favorable localities, each herd being under the control of a chief herder and the necessary number of assistants. The chief herder's duty was, also, to have every animal branded, a record of which was kept in the shape of a notched stick, or *Bali*, which was regularly submitted to the *major domo* of the Mission. Fig. 1 represents a stick of this kind, now in the collection of Mr. Coronel of Los Angeles.

The stick is about twenty-four inches in length, and three-fourths of an inch thick in diameter, each way. The handle has the edges bevelled and upon each of the four faces thus produced are the characters I, II, X, ⊳, signifying respectively bull, cow, heifer and ox. For cattle, the end opposite the handle is notched, thus giving the rude idea of horns. For horses, the end is pointed, in imitation of the sharp ear of a horse. When the stick is used by a herder of horses, the same marks are used, upon the handle, as for cattle, but with the signification, in order, as follows: stallion, mare, colt, gelding. Whenever an animal is branded, a notch is cut into the sharp edge of the proper stick, and upon the line of the character on the handle to designate the sex or age of the subject. Thus an accurate record was kept of all stock handled, a custom and method which was copied by the Mexican herders and retained until a few years ago.

Notched sticks were also used by the herders and laborers to record their accounts with the *major domo*. These sticks were nicely worked out of dogwood, polished, though not quite as long as the above. Only two sides were used, one bearing the character |⊠|, for money, and a simple line cut crosswise, for work. On the money side there were notches for *reals* and long cuts, extending across the stick, for dollars. Upon the opposite side notches for days worked, and lines across the surface for weeks. In this manner credit could be given on the "money side," and there was always exactness between these stick records and those kept in proper form by the superiors.

Other records were also examined by the writer, in which

the authors had recourse to paper; at the top of the sheet was a representation of the brand used, and beneath the regular number of short and long lines, denoting the decimal system of recording. Sometimes small rings were inserted at every tenth point, instead of the longer vertical stroke.

When a rancheria possessed cattle only, there was no necessity for notching the end of the stick to denote "cattle," as there was no cause for error. Consequently the sticks were cut off transversely, without any specific pointing or notching. The same was adopted, also, where horses were owned, exclusively.

Tattooing was practised and nearly all of the older members of the tribe still bear faint lines upon the chin; this is noticeable to a greater extent among the women than the men. At present, personal ornamentation is done in colors only, applied in the form of vertical lines upon the chin, transverse bars upon the cheeks, or both. The tattoo design worn by a land-owner, formerly served as a property mark by being cut or painted, upon trees or posts selected to indicate the boundaries. These marks were almost equivalent to the owner's name, and were known to the remainder of the tribe. In this respect of engraving tattoo marks upon the bark of trees, there is great resemblance to a custom practised by the natives of New Zealand, where the facial decorations of a dead man are reproduced upon trees near his grave; this is equal to an autograph and can be readily interpreted by a native.

Knotted cords were used by some of these Indians, in business transactions, a custom adopted after their northern neighbors, the Palonies,— a sub-tribe of the Chemehuevi,— so called by the Spanish settlers, on account of wearing the hair cut so short as to suggest the idea of "baldheadedness." The method of using knotted cords was in the following manner: Each year the Paloni selected a certain number of their tribe to visit the settlement to sell native blankets, and every one who sent goods provided the salesman with two cords, twisted out of the hair of some animal, on one of which a knot was tied for every *real* received, and on the other, the number of blankets sold. When the amount reached one dollar, a double knot was made. Upon the return of the agent, each person would select his own cords, count up the number of blankets sold and the amount received for the goods, for which the seller was responsible.

3. The combination of the letters *g* and *h* is intended to represent the sound of the Spanish *j* in *mujer; ach*, German, etc., now expressed by the character χ. In the MS., Mr. Ried wrote the letter *g* over the *h*.

4. During the time of the writer's recent investigations among the few Indians remaining in the vicinity of Santa Barbara, he learned the tribal designations of that people, which they gave as Síoqtun′. The band occupying the region about the Cathedral Oaks, was known as the Smúwitsh. That located nearer the coast, at the Partera, the Saq′pili′. All town villages, *i. e.*, at Santa Barbara, were called Mikíquĕ. The Indians formerly living in Santa Cruz Island (now extinct) termed themselves Tshúma. (In the preceding words, the *q* has the sound of *ch*, in German *nicht*).

5. The word, at the present time, is *iu′at.*

6. Three forms of war-clubs are given in Figures 2, 3 and 4. They are all made of extremely hard, heavy wood, and in some examples there is evidence of an attempt at ornamentation, done in lines burnt upon the surface, no doubt with a metallic substance. The club represented in Fig. 2, measures thirty-four inches in length, one and a quarter inches in diameter near the handle, and two and a half inches at the opposite end; Fig. 3 measures eighteen inches in length, the handle two and a half inches in diameter, while the four-sided head, four inches each way, is armed with sharp conical points of wood projecting nearly an inch above the surface. These projections are of hard wood, and are secured by a socket, into which the pieces were driven previous to pointing.

   Fig. 4 is of the same length as the preceding; it has three sides, each face measuring four inches in width, with just sufficient handle to afford a good grasp.

   The object represented in Fig. 5 was used as an accompaniment to the rattle, in dances. Two pieces of hard wood twenty inches long, each two inches broad and a little more than half an inch thick, are secured at the handle with thongs and vegetable gum, allowing the ends of the wooden blades to be about an inch apart. This is shaken, and makes a noise resembling clapping of hands. Fig. 6 is a rattle, made by passing a wooden handle through two boards, each three and three-fourths by four inches in width, over which rawhide is stretched to form a hollow case. Inside of this are seeds, and small stones. The top is ornamented with feathers.

7. Rabbits were killed with the *Makána*, or boomerang, the form of

which is given in Fig. 7. The original measures two feet in length in a straight line, one and one-fourth inches across at the handle and one and three-fourths inches at the broadest part. The average thickness is about three-fourths of an inch. The weapon is made of hard wood (apparently dogwood, or mesquite), and ornamented with various markings which are burnt upon the surface. The end opposite the handle is finished so as to imitate the head of what appears to be a snake.

When viewing the weapon edgewise, it will be observed that considerable curve exists, but it is not known that these Indians were ever acquainted with the art of throwing the Makána so as to produce the strange and erratic motions pursued by a boomerang at the hands of a native Australian.

The weapon was thrown near the ground, so as not to pass over a rabbit while it was running. Its general form seems similar to the Zuñi Kléani, and a similar weapon used by the Moqui, a notice of which was first published by the writer in the Trans. Anthrop. Inst. of Great Britain and Ireland, Vol. IX, p. 464.

8. The black beads referred to are made of dark, greenish black serpentine, some specimens resembling diorite, excepting as to hardness. They vary in size; the smallest one measuring about one-fourth of an inch in diameter and one-eighth in thickness, and the largest, known to the writer, measures seven-eighths of an inch in diameter by one and a half inches in length. The perforation in this specimen is one-fourth of an inch in diameter, and presents transverse striæ caused by the sand used in drilling.

The shell beads were usually made of *Haliotis* and *Tivola.* Shell money-beads were flat, and about one-third of an inch in diameter. Other beads used for necklaces were cylindrical or sub-cylindrical, larger in the middle than toward either end. Many of them, found in graves, present the same style of delicate perforations as we find in the beads from Santa Cruz Island. The writer is of the opinion that these narrow perforations were made by means of sea lions' whiskers as drills, and extremely fine silicious dust. The channels are scarcely large enough to admit a good sized thread, and in several beads which have split lengthwise it is apparent that drilling was done from both ends, as the perforations cease a short distance beyond the middle of the bead, thus passing one another, perhaps less than the tenth of an inch. It is evident, from the appearance of other unfinished specimens,

that the boring was begun by using a stone drill — of which many and various forms occur — after which the bristle was applied. The channels are slightly conical toward the outer end, and at about one-fourth the length of the shell there is a constriction beyond which and near the middle of the bead, the channel again becomes wider, assuming an elliptical form. No doubt the rapid rotary motion of a flexible drill would cause sufficient divergence to produce such an effect. In addition to this, delicate transverse striæ are also visible without the aid of a lens. A body was recently discovered on Santa Cruz Island, with which was obtained a bunch of these bristles carefully wrapped from end to end. Furthermore, it is well known that Chinamen on the Pacific coast purchase all the bristles of the sea lion that can be obtained, paying twenty-five cents apiece therefor, to be prepared and sold as tooth-picks.

Most of the shells required for use were obtained at the Santa Catalina Islands. These, as well as the islands opposite Santa Barbara, are fine localities for Haliotis shells even at this time. The Serpentine, used in making beads, ollas and large rings, was also obtained at the islands first named.

9. Between Los Angeles and the coast, near San Pedro, gravestones were erected to the memory of the deceased, or, perhaps simply to identify the location of the body, so that his friends might come to offer food, and to mourn. Fig. 8 represents the etchings upon a piece of sandstone slab obtained from the above mentioned locality. On account of the fracture of the specimen, and the loss of, perhaps, important parts, only a few characters are visible, but these, resembling whales, were evidently carved there to show that the deceased had been a fisherman or whale hunter. Such a custom prevails very extensively among the Kiatéχamut Innuit of southern Alaska. There, the profession of a man, and even a woman, is carefully recorded upon wooden slabs.

10. The term Shaman is more appropriate in this connection. The Seer was an individual whose profession was distinct from that of the Shaman. With some tribes there are Rain-makers, etc. During the performance of religious or professional ceremonies, the Shaman resorts to many and various utterances and movements not understood by the unitiated. Rattles, small dried animals or skins, curiously shaped vegetable growths, rare sparkling minerals and wrought stones of odd forms, are employed as fetishes. Among the last named the writer found both oblong and pyriform polished

stones, such as have hitherto been considered, and described, as "plummets, plumb-bobs, sinkers, and weights." An old Tobikhar said that such stones would require too much time and labor to be used only to cast into the sea. The Indians term them "medicine stones," and consider them as possessing medicinal properties.

That the Shaman also prepared arrow-poison, there is no doubt. Nearly all of the tribes between the Pacific ocean and the Rocky mountains had more or less knowledge of plants, insects, or other materials, which rendered it capable of producing septicæmia in any person or animal wounded thereby. For more extended information by the present writer, respecting the methods of preparation, and the tribes by whom used, see *Bull. Société d'Anthropologie de Paris*, Vol. VI, 3rd Series, 1883, p. 205, *et seq.; Verhandl. Berliner. Gesell. für Anthrop. Ethnol. und Urgesch.*, 1880, p. 91, *et seq.*

11. Although the author says that siphylis was unknown, there is every reason to suppose that this disease made its appearance among the coast and island Indians at a very early day. A skull, which the writer obtained at Santa Cruz Island — and has in his possession still,— shows great destruction over the left parietal bone, beginning at the temporal bone and extending backward and upward, so as to embrace the surface of nearly the lower half of the temporal, while on the frontal bone the erosion extended to greater depth, taking in part of the external portion of the supra orbital ridge, thence upward for about one inch and across the forehead to a point above the middle of the right orbit. In the middle of these eroded areas are the more recent deposits of bony matter, forming, what may have been a healthy reconstruction of the parts. The skull is an extremely interesting one, and the only specimen of this kind known to the writer to have been obtained at that locality. From the general style of burial, and the primitive forms of the relics obtained from the grave, there is every reason to believe that the body was not of recent years.

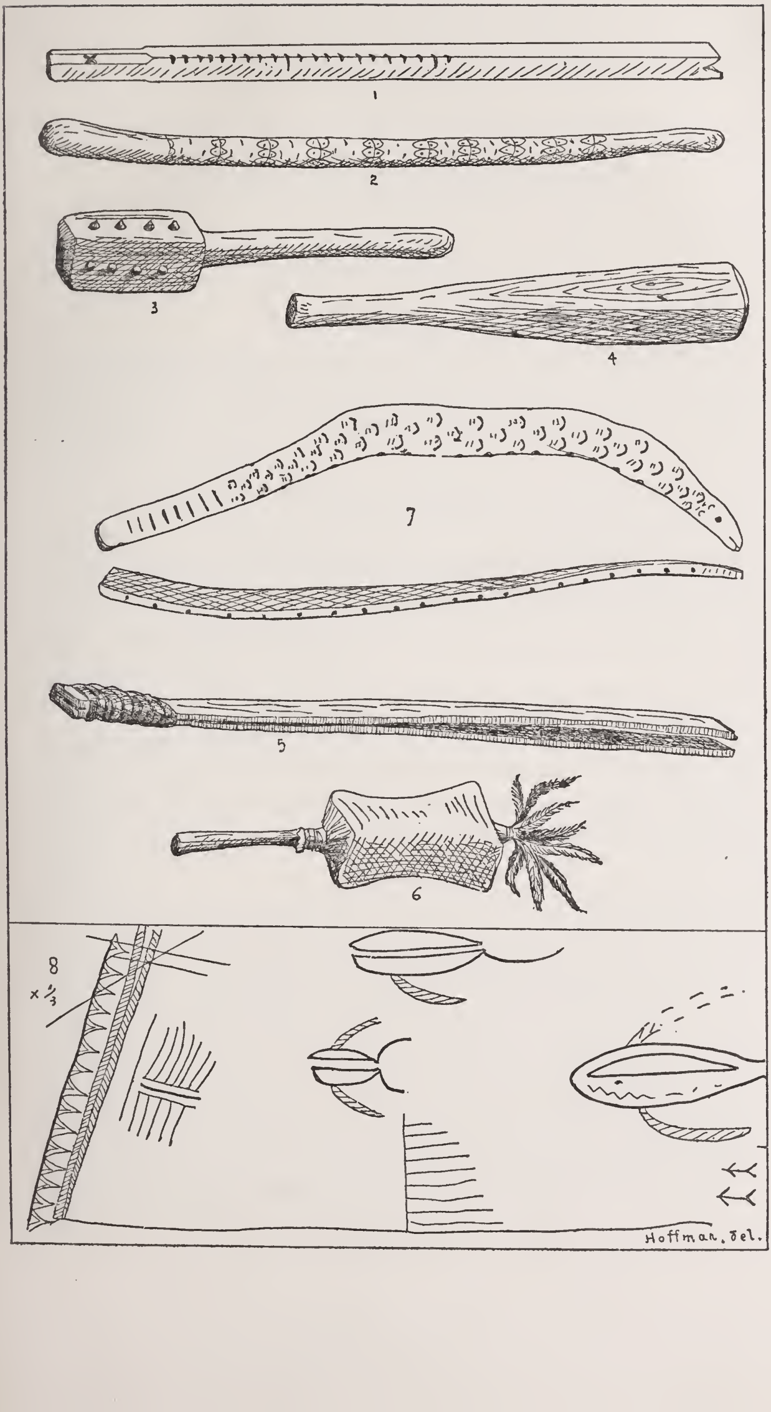
12. This game was played by many tribes of Indians, and was called "Chunkee" by Adair, who observed it among the Muskoki. The writer saw it played by the Coyotero Apaches, in 1871, at Camp Apache, A. T., and an extended notice of the subject was printed in the *American Naturalist*, 1878, Vol. XII, pp. 478–481.

The Indians at Santa Barbara also played a similar game, using a barrel-shaped stone ring, three inches in diameter

and four in length, at which the players shot arrows, the idea being to penetrate the hole while the ring was in motion. The players stood upon either side of the course.

13. Probably the country of the Mojaves, the tribal name of which is Amoχawi or Amoχami. The western range of their territory formerly extended along the northern slope of the San Fernando range, but how far westward is not known.

14. Tuñas, generally known as prickly pears, are the edible fruit of several varieties of Opuntia, or broad-leaved cactus. These were sometimes crushed and mixed with the meal of seeds or acorns. Many of the mortars found in southern California, are merely circular, flat stones, having a slight depression on one side upon which the pounding was done. To prevent the scattering of seed, a funnel-shaped basket was constructed, similar to those used for carrying fruit, etc.; the lower apex was cut off allowing the hole to be nearly as large as the stone mortar. The cut edge of the basket was then temporarily secured to the mortar by applying a thick coating of bitumen. The basket thus served as a hopper. When the surface of a mortar became smooth by use, it was again roughened by pecking it with a sharp piece of quartz or chalcedony, both of which are abundant.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OPENING OF HATTERAS INLET.

COMMUNICATED BY WILLIAM L. WELCH.

Hatteras Inlet is on the coast of North Carolina, between Cape Hatteras and Ocracoke Inlet, about twelve miles from the Cape, southwest; and fourteen miles northeast of Ocracoke.

It is mentioned in Blunt's Coast Pilot, but not in the Gazetteers, or Encyclopædias: it is surprising that no account of this Inlet and harbor so remarkable in itself, and of so much interest in the late war, by reason of the Burnside Expedition passing through it, can be found in any of these books of reference.

The writer was stationed at Hatteras Inlet in the summer of 1864, for about a month, and was then told by one of the native pilots (Reuben Quidley) that the place where the inlet is, and the water three or four fathoms deep, used to be dry, solid land, and that he (Quidley) had often walked over it.

When in Jan., 1884, the writer undertook to determine the date of the opening or cutting through of this Inlet, he consulted everything attainable, without success, and as a last resort, wrote (Jan. 12th) to the U. S. Coast Survey at Washington, D. C., for such particulars as they could and would communicate. In the answer to this (dated Jan. 21st) the information was received, that the first survey of the place in question, was made in 1850, and the results were published in the Coast Survey Reports for 1851—and further

"No mention is made of the inlet having been recently formed. I have written to the officer who made this survey and also to others who from their age and interest in the locality would be likely to know something of it, and so far as any of them know, the inlet has existed from remote times. Can your question refer to Oregon Inlet, at Bodie's Island, considerably higher up the coast? That inlet was formed by the hurricane of Sept. 8, 1846."

This answer was not satisfactory, and Jan. 25th, a communication was sent to Hon. Thos. J. Jarvis, Governor of North Carolina, asking the same questions, and giving the result of the enquiry at Washington, as set forth above.

Jan. 28th the Governor replies:

"There was a time in the present half century when there was no Hatteras Inlet. It was cut out in some great storm within that time. I cannot to-day give you the exact date, but will do so soon."

This was encouraging, but the matter lay dormant until a letter was received from Gov. Jarvis, dated April 14, as follows:

"After considerable delay, I have at last got upon the track of the information you desired as to the opening of Hatteras Inlet. It took me some time to get hold of a man who could fix the exact time. I have inquired of many and most of them like myself had a general idea of the fact that it was cut out some forty years ago."

A letter dated April 22d was next received from Gov. Jarvis, enclosing one from Col. Jno. D. Whitford of New Berne, N. C., to the Governor, and one from Redding R. Quidley, Esq., of Hatteras Inlet to Col. Whitford. Col. Whitford's letter contained an account of a chart in his possession dated 1738, made by James Wimble, on which an inlet is shown between Ocracoke Inlet and Cape Hatteras; and Mr. Quidley's letter contained an account of the cutting through of the present inlet in Sept. 1846.

Here was a starting-point, and the next step was to determine, if possible, when the old inlet closed, where it

was situated, and if it could or could not be identified with the present inlet. The writer in the meanwhile had sent a letter to the Secretary of War, asking for, and had received (through the Engineer Department), "Appendix G of the Annual Report of the Chief of Engineers for 1876, containing the Annual Report upon the Improvement of Rivers and Harbors in . . . . . North Carolina." In this, the report of S. T. Abert, U. S. Civil Eng. to Brig. Gen. A. A. Humphreys, Chief of Eng. U. S. A., has a "Table showing comparative conditions of the Inlets on the coast of North Carolina at different dates," giving with others the condition of Hatteras Inlet as shown by maps of Hariot 1585, Lawson 1708, Wimble 1738, Mouzin 1775, Atlantic Neptune 1780, Lewis 1795, and U. S. Coast Survey 1875. In each and every one of these charts or maps, Hatteras Inlet is indicated as being open, and the table shows that the Engineer that compiled it, understood, and intended to convey the impression, that the same inlet was there in 1875 that existed in 1585 and that it was at the same place on the coast.

A search by the writer among the old charts in possession of the Essex Institute, Salem, Mass., was the means of discovering a "Chart of the Coast of America from Cape Hateras to Cape Roman from the actual Surveys of Daniel Dunbibin, Esq." This chart is bound with others in "The American Pilot" published at Boston by William Norman, Book and Chart seller, an edition of 1794. This chart has no inlet between Cape Hatteras and Ocracoke, and gives 4 fathom of water on bar at Ocracoke, and 9 ft. 6 in. shoalest water on bar inside. A careful perusal of the available histories of North Carolina in the Boston Public Library was made, and in Vol. 2 of Martin's History of North Carolina, page 184, this paragraph occurs :

"1764. A chart of the sea coast having been made by Daniel Dunbibbin, was this year published by his widow, to whom the legislature allowed a small premium."

This last information seems to indicate that the charts of Mouzin 1775, Atlantic Neptune 1780, and Lewis 1795 (mentioned before) are, as regards an inlet between Cape Hatteras and Ocracoke Inlet entirely wrong, and are simply copies of Wimble's or some other older chart. The letter of Mr. Quidley, received in April through Col. Whitford and Gov. Jarvis, was dated at Hatteras Inlet, N. C., Apr. 7, 1884, and says:

"I will say in regard to your request, that Hatteras Inlet was cut out by a heavy gale, a violent storm on the 7th of Sept., at night, 1846. The first vessel that passed through into Pamlico Sound, was schooner Asher C. Havens, on the 5th day of Feb'y, 1847, Capt. David Barrett, Commander: I was pilot of said schooner, conducted her through all safe. No other vessel had ever passed through the Inlet. The first vessel that ever crossed over the bar of Hatteras Inlet was in Jan., '47. I was then a licensed pilot for Ocracoke Inlet, got on board to pilot the schooner into Ocracoke, wind came ahead, I went into Hatteras Inlet for harbor, stayed all night, went out next morning and went into Ocracoke. I cannot give any correct report what time the first vessel passed out, it was not long after the first passed through; the second vessel passed through about two weeks after the first, it was a small steamer bound through Core Sound, I piloted it through."

In another letter to the writer of this, Mr. Quidley says:

"I was licensed to pilot at Ocracoke Inlet in 1831; I then lived at Hatteras and when I piloted a vessel in at Ocracoke, which very often would be two, three, or four a week, and walked home to Hatteras, there was nothing to cause me or any one, to have any idea that there would be an inlet there, sooner than any other part of the beach; there was no water passed over the place except in those heavy easterly gales, when as a general thing it passes over nearly all our beach from Hatteras to Ocracoke. The day the inlet was cut out, there were several families living where the inlet is now, they had no more thought of seeing an inlet there, than of any part of the beach, but to their great surprise, in the morning they saw the sea and sound

connected together, and the live oaks washing up by the roots and tumbling into the ocean. I was well acquainted with the growth of the land where the inlet now is, I lived with my brother where the inlet is now. I have worked with him cutting wood and chopping yopon, where now, I have no doubt there is three or four fathoms of water; the growth was live oak principally, did not grow tall, but large trunks and spreading limbs. I had an old uncle lived about where the inlet is, who had a fine fig orchard, and many peach trees on his lot, with fine potato patch and garden."

Again he writes:

"Since I wrote you last, I have conversed with the two oldest men living on this portion of the Banks (one is in his 75th year, the other in his 72d), both born and raised where the inlet is now.

John Austin, the eldest, says he remembers his grandfather very well; he says he has heard the old gentleman say, there was an inlet about six miles southwest of where the inlet is now; he states that the old man said there was an English vessel, a ship, ran on the bar of said inlet, and was lost, and the wreck sanded up and the beach made down to it and finally closed up the inlet; Mr. Austin's grandfather's name was Styron; died Mch. 7, 1825, aged 86 yrs.

The other man I talked with was William Ballance. He says his father died in 1826, 68 years old; he says he heard his father say that he had seen a piece of wreck standing up, right at, or near the place that Austin speaks of as being the place where the inlet was, and had been told by older people, that it was the stern post of the vessel that closed up the inlet. This place that they speak of is about five or six miles from this inlet we have now, between two points known now as 'Shingle Creek' and 'Quake Hammock.'"

In a letter from Mr. Quidley dated Sept. 29, 1884, he says:

"The Shingle Creek is about 5 miles from Hatteras Inlet, is 40 or 50 yds. wide, makes up through a portion of marsh and a low growth of woods or bushes to the beach, but not through the beach; and a little to northeast of it there is another creek, about like the one just named, called the "Old Inlet Creek," which I think might take its name from being somewhere near where the inlet was. The "Great Swash" is a level place of beach, nothing growing on it but some grass or sedge next to the sound side, and extends about a mile to next growth of woods called "Knole": the Quake Hammock is a small clump of woods lying between Shingle Creek and Great Swash.

I cannot give the exact time that vessels left off passing through

Ocracoke. I was one of the first Commissioners of Navigation appointed for Hatteras Inlet, I think in 1852; there has been but very little passing through Ocracoke Inlet since 1855; there is no vessel passes through there now except perchance, that a vessel goes in case of distress of weather, or head winds, and draws light draught of water, 4 or 5 feet."

To sum up: we find on the old charts of the coast of North Carolina from those of 1585, to that of James Wimble 1738, an inlet indicated between Ocracoke Inlet and Cape Hatteras and about eight miles northeast of the former, known as Hatteras Inlet, which from the evidence given must have closed near the middle of the last century; for the chart of Daniel Dunbibbin was published by his widow, in 1764, and this was made from actual surveys, and it has no inlet between Ocracoke Inlet and Cape Hatteras; and we must conclude that all charts of that coast quoted in the paper above, made later than Dunbibbin's, are faulty in the matter of this inlet, and are simply copies of some previous chart. We also conclude that the claim of the U. S. Coast Survey authorities that the present inlet at Hatteras has "existed from remote times," and that of Mr. Abert, that this present inlet is identical with that of 1585 is erroneous; for the evidence given cannot be controverted that the present Hatteras Inlet was opened by the great gale of Sept., 1846, which was so severe on our southern coast.

This paper and its conclusions are respectfully referred to the U. S. authorities and the publishers of Gazetteers and Encyclopædias for their adoption.

THROUGH WHICH INLET DID THE ENGLISH ADVENTURERS OF 1584 ENTER THE SOUNDS OF NORTH CAROLINA.

ALSO

SOME CHANGES IN THE COAST LINE SINCE THEIR TIME.

COMMUNICATED BY WILLIAM L. WELCH.

THE following extracts are from the report of the voyage under Amadas and Barlowe (written by Barlowe) made in 1584. After mentioning their arrival upon the coast, they say;

"We sailed along the same a hundred and twenty English miles before we could find any entrance or river issuing into the sea. The first that appeared unto us we entered, though not without some difficulty, and cast anchor about three harquebus-shot within the haven's mouth, on the left hand of the same."

"This land lay stretching itself to the west, which after we found to be but an island of twenty miles long, and not over six miles broad."

They speak of visits of the Indians, and then say

"After they had been divers times aboard the ships, myself with seven more went twenty miles into the river that runs towards the city of Skicoak, which river they call Occam; and the evening following, we came to an island, which they call Roanoak, distant from the harbor by which we entered, seven leagues; and at the north end thereof was a village of nine houses." "Beyond this island there is the main land, and over against this island, falls into this spacious water, the great river called Occam by the inhabitants, on which stands a town called Pomeiock, and six days journey from the same is situate their greatest city called Skicoak." "Into this river falls another great river, called Cipo, in which there is found great stores of muscles, in which there are pearls; likewise there descendeth into this Occam, another river called Nomopam, on the one side whereof stands a great town called Chawanook." "Towards the southwest, four days journey, is situated a town called Sequotan, which is the southernmost

town of Wingandacoa, near into which, six and twenty years past, there was a ship cast away, whereof some of the people were saved, and those were white people, whom the country people preserved. And after ten days remaining in an out island uninhabited, called Wocokon, they with help of some of the dwellers of Sequotan, fastened two boats of the country together, and made masts unto them, and sails of their shirts, and having taken into them such victuals as the country yielded, they departed, after they had remained in this out island three weeks."

This report was accompanied by a sketch of the coast and adjacent country, as they found it, extending from perhaps forty miles north of Roanoke to ten miles south of it; it has five inlets drawn on it, the southern one is north of the southern end of Roanoke Island, the next perhaps five miles north of that; the first one north of Roanoke Island, and also north of an island apparently "Collington's", is marked "Trinity Harbor", and there are two north of this, the most northern one, might be "Old Currituck Inlet"; off these most northern inlets, are anchored the two ships of the adventurers, and inside apparently sailing from "Trinity Harbor" to "Roanoke Island" is a boat with one square sail, full of men; from these, this sketch and the text of their report, the writer concludes that *they entered at "Trinity Harbor," north of Roanoke Island, which inlet was about where "Caffey" inlet used to be;* that their river Occam was our Albemarle Sound; that their river Nomopam was our Chowan; and that Wocokon, our Ocracoke, was to them an unknown place; that is, they did not visit it, for if they had, it would be reasonable to suppose their sketch of the coast would have included it. Bancroft in his History of United States says they entered at Wocokon (our Ocracoke) but it is simply an assertion, and can not be proved. Hawks' History of North Carolina gives New Inlet, south of Roanoke Island, as the place of entrance; and that the Occam was a part of the

sound between a line of islands parallel to the coast, one of which was Roanoke; but, as New Inlet was not open at that time, and the river Nomopam, on which stood "Chawanook" does not fall into Roanoke Sound, this theory fails. Mr. Abert, U. S. Civil Eng. follows Bancroft, and to provide a river Occam, he connects Alligator River with long Shoal River making one long river of them, but the same objection affects his river as that of Hawks'; he also fails to convince himself that Roanoke Island is seven leagues only from Ocracoke Inlet; most probably his mistake arises from confounding Pomeiock, a town on Albemarle Sound (at or near Edenton) with Pomouik, near Secotan, on or near Mattamuskeet Lake; other authors place the entrance of Amadas and Barlowe at either Ocracoke or Hatteras Inlet. John W. Moore, in his history of North Carolina, published in 1880, places the entrance at Trinity Harbor "*nearly opposite Roanoke Island*"; this last is the nearest of any to what the writer considers the facts, but as the inlet entered was seven leagues from Roanoke Island, *Caffey Inlet was in all probability the place of entrance.*

SOME CHANGES IN THE COAST LINE SINCE 1584.

Mr. Abert, U. S. Civil Eng., in the Table of Condition of Inlets, in his report to War Dept. in 1876, says the inlet known as Hatorask in 1590, New in 1738, Gunt in 1775, Gant in 1795, is the same as that known on U. S. C. Survey chart of 1875 as Oregon: in this he is evidently mistaken, if we may rely on the evidence of the U. S. C. Survey office, that Oregon Inlet was opened in 1846. In the same table, the Hatteras Inlet of to-day is given as being identical with that of 1585; but the evidence of R. R. Quidley and other residents of Hatteras, must be taken as conclusive, that the present Hatteras Inlet was also opened in 1846. He also says:

"The same inlets now exist between the outlying islands, and the same shoals are now found off the coast, as were found by the navigators of 1584. The beach, banks, barrier reefs, or whatever they may be called, appear to have been much wider than at the present time. This seems to have been notably the case near Cape Hatteras. The preservation of the status of the bars at the inlets for so many years indicates a permanence in the relation of the forces by which they are maintained."

Of the inlets on the coast of North Carolina from near Cape Henry to Ocracoke Inlet, that were open in 1585–90, not one, except Ocracoke, is open to-day, and Ocracoke is of little use to navigation: there was no inlet between those near, and north of Roanoke Island, and one which appears on the maps as being at Cape Hatteras. The date of closing of the inlet at Cape Hatteras it is impossible to give, but that there was one admits of no dispute; the old maps give it, and in the report of the last voyage made by John White in 1590, appears this:

"On the twelfth, in the morning we departed from thence, and toward night we came to an anchor at the northeast end of the island of Croatoan, by reason of a breach which we perceived to lie out two or three leagues into the sea; here we rode all that night." "This breach is in thirty-five degrees and a half, and lays at the very northeast point of Croatoan, where goes a fret out of the main sea into the inner waters which part the islands and the main land."

As was the course in those days, White had made the West Indies first, then the coast of Florida, and was coasting along towards Roanoke Island, and the day before the event chronicled above had anchored off Cape Lookout, or near Beaufort. Croatoan was that part of the coast lying northeast and southwest, between old Hatteras Inlet and the inlet at Cape Hatteras.

The latitude given in the extract above would place the breach and fret rather north of the present Cape Hatteras, but an error of 15′ to 25′ in those days, would not be too much to suppose.

The trend of the coast to-day from Cape Henry to within twenty-five miles of Cape Hatteras is southeast; for the next twenty-five miles it is nearly due south, except that, from a few miles north of the Cape it is a little to the west of south. The old maps of 1585–90 give, just south of Roanoke Island, a coast line running nearly east, and so far, that the extreme point was far east of Cape Hatteras, then taking a southwest direction to within a few miles of Cape Hatteras; it must have been on this point that White, in his last voyage, just escaped being wrecked, and here also were hills, designated as "Kenrick's Mount": some heavy storm, or series of storms, or some great convulsion of nature has entirely carried this away, and perhaps opened Loggerhead and New Inlets. Platt and Wimble shoals are, perhaps, all there is left of this large extent of land.

The charts of Wimble and Dunbibbin, both give Cape Hatteras as jutting out into the ocean like a sharp elbow, while to-day, the cape as shown by the U. S. Coast Survey charts is rounded in and the point all carried away.

These changes, noted above, are well worthy the attention of the U. S Coast Survey and Engineer Department, U. S. A.

BULLETIN

OF THE

ESSEX INSTITUTE.

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ON THE CARAPAX AND STERNUM OF DECAPOD CRUSTACEA.*

BY HOWARD AYERS, Ph.D., Ann Arbor, Mich.

The determination of the homology of the carapax and sternum among the Crustacea is rendered difficult by the endless variety of forms assumed by their constituent parts, and the consequent perplexing differences in the relation of these parts to each other. Before stating the conclusions and arguments in favor of the solution at which I have arrived after a study of several forms chiefly of the Decapod type, it may conduce to clearness to give in a few words, the main facts and conclusions of the previous writers on this subject.

Although Huxley (1) is the latest writer who expresses views on the homologies of the Crustacean carapax, he offers no new explanation but adheres to the old conception of a fusion of the terga of the fourteen anterior somites into a carapax. He writes (in describing *Astacus fluviatilis*) "The carapace, therefore, corresponds in position with the terga and tergal halves of the pleura of all the somites which are thus reflected into it, and these somites

* This paper was prepared in the Mus. Comp. Zoöl., under the direction of Prof. W. Faxon, in the college year 1882–83.

include all, without exception, from the last thoracic to the ophthalmic. * * * " At the sides of the antennulary and antennary somites the rostral prolongation of the carapace is the direct continuation outward of the epimera of these somites, and there is nothing to be compared to an apodeme, but the sternum of the ophthalmic somite after giving off the lamella which forms the inferomedian rostrum, is prolonged on each side of the middle line backwards and outwards into a free, expanded, thin, calcified process which applies itself against the carapace by its upper surface, and by its under surface gives attachment to the anterior gastric muscles. * * * On the dorsal surface there is no indication of any division of the carapace into terga corresponding with the sterna of the somites, but it is marked by a well-defined curved groove. * * * " The accompanying diagram explains his views of the somite in *Astacus*.

Milne-Edwards(2) considers the carapax in the majority of the Decapods to consist of a single piece, part of

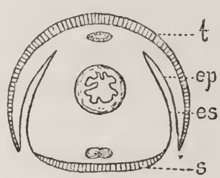

Diagram of crustacean segment; *ep*, epimerum; *es*, episternum; *s*, sternum; *t*, tergum.

which is furnished by the antennary and mandibulary somites respectively. This author states, that while in Squilla the carapax belongs almost entirely to the antennary segment, in Limnetis on the other hand, it pertains chiefly to the mandibulary somite. Furthermore, the tergum of the antennulary segment is entirely wanting in the Deca-

pods. He continues (*loc. cit.*, p. 233), "J'ai fait voir, dans un autre écrit que le carapace, lors même qu'elle recouvre la totalité du thorax aussi bien que toute la portion céphalique du corps doit être considérée comme une portion de la tête dont une portion du squelette s'est développée d'une manière excessif, et a chevauché en avant et en arrière sur les parties voisines ; j'ai établi aussi qu'elle appartenait au système des pièces tergales, et qui celles-ci n'étaient fournies ni par les anneaux ophthalmique ou antennulaire, ni par les zoonites céphaliques postérieures. Il me paraissoit probable qu'elle dépendait de l'anneau antennaire ou de l'anneau mandibulaire, c'est-à-dire du troisième ou du quatrième anneau de la tête, mais qu'elle ne procédait que d'un seul ces zoonites. Les faits dont il vient d'être question permettent de rectifier une partie de ces conclusions, et d'arriver à une approximation plus grande de la vérité. Effectivement l'arceau céphalique de la carapace des Décapodes me semble ne pouvoir être qu'une dépendence de l'anneau antennaire, tant à raison connexions avec les autres pièces du squelette tégumentaire, qu'en conséquence de l'origine des nerfs dont ses parties molles sont pourvues, puisque ces nerfs proviennent des ganglions cérébroides ou sous-œsophagiens, tandis que les nerfs appartenant au appendices du zoonite suivant, ou anneau mandibulaire, naissent des ganglions post-œsophagiens. Mais l'arceau scapulaire ou postérieur de la carapace de ces Crustacés doit pour des raisons analogues, être considéré comme étant étranger au troisième zoonite céphalique, et comme appartenant à l'anneau mandibulaire. La carapace serait donc un organ plus complexe que je ne le supposait d'abord, et serait formée par deux anneaux tergaux, dépendant du troisième et du quatrième anneaux de la tête, arceaux qui fournaient d'une indépendance presque complete chez les Paguriens et les Thalassines, mais ne seraient

représentés chez les Décapodes ordinaires que par un seul segment dorsal dû à l'ossification diffuse ou fusion des élémentes sclerodermique de toute la portion du squelette tégumentaire correspondant à ces deux arceaux. Mais chez les Crustacés inférieures, la carapace ne paraît avoir d'ordinaire une composition plus simple, et être formée tantôt par les analogues de l'arceau céphalique seulement, tantôt par les représentants de l'arceau scapulaire. Ainsi, chez les Squilles, la portion céphalique de la carapace est très-dévellopée ; mais toute la portion postérieure au scapulaire paraît manquer complétement, et chez les Limnadies, au contraire, l'espèce de coquille bivalve, qui tient lieu d'une carapace ordinaire, me paraît être due au développement excessif de la portion scapulaire seulement, et dépendre de l'anneau mandibulaire, ont peut-être même de l'un des zoonites suivant." Owen (3) reflects Milne-Edwards' views throughout as quoted above. Dana (4) differs from Milne-Edwards in that he considers the lateral (ventral) plates of the carapax of crabs to be true *terga* instead of epimera (*loc. cit.*, p. 27). He infers "that the epistome (or its anterior part) belongs to the second, or to the second and first normal segments, that is, to the antennulary or to the antennulary and ophthalmic segments. For convenience of reference I have compiled the following table from the author's statements of his views regarding the number of segments and what parts of each enter into the composition of the crab carapax.

1. Ophthalmic somite. Parts entirely wanting; appendages, however, *present.*

2. Antennulary somite. Sternum present (probably fused with the ophthalmic sternum into one piece); the other parts wanting; appendages present.

3. Antennary somite. The parts (sternum, tergum, episternal plate) present.

4. Mandibulary somite. The sternum, episternal plates, epimeral plates and tergum present.

After stating in a very clear manner the facts he had established, the author draws the following conclusions. The carapax of the Brachyura includes:

I. The first and second normal segments represented by the epistome, or its anterior position, and the inter-antennary septum.

II. The third normal segment, represented by the main body of the carapax, and the anterior portion of the prelabial plate or palate.

III. The fourth normal or mandibular segment represented by the posterior and outer part of the prelabial plate and the ventral pieces of the carapax.

Concerning the carapax of the Macroura the author again differs from Milne-Edwards in designating the lateral and posterior plates of the carapax of *Astacus mandibular terga* instead of epimera. After a careful comparative description of numerous forms both among the Macroura and the lower Crustacea (*loc. cit.*, pp. 32–37) in which he mentions several seemingly adverse cases, the author concludes that the origin of the carapax and the disposition of its parts are essentially the same throughout the class.

From the foregoing extracts it will be seen that Dana's views are in advance of those of the other investigators, but there yet remain several points of interest on which it is desirable to collect further evidence. Both Milne-Edwards and Dana have established with a high degree of probability the origin of the carapax from the terga of the mandibulary and antennary somites, but neither of them succeeded in finding a conclusive demonstration of the fact. In the very young *Squilla* the thoracic and abdominal segments of the body may, by careful dissection, be removed from their connection with the carapax, without disturbing the relation of the parts in intimate connex with the latter. In such a preparation the point of attachment will be seen to lie immediately behind the *mandibulary sternum*, fig. 15, z. Since both the *ophthalmic* and the *antennulary* segments are *entire and have no connection*

with the carapax it follows that the carapax in the young *Squilla* pertains to the antennary and mandibulary somite —to these and these only. The same is true of the zoea of *Porcellana.* The relations of the carapax in the young stages of *Cancer* and *Carcinus* could not be made out accurately, owing to the poor state of preservation of the specimens at my disposal. Among the Brachyura the tergum of the ophthalmic somite is *present as a distinct plate beneath the carapax* and may be exposed by cutting away the rostral region of the carapax, or it may sometimes be seen from behind (*e. g.*, *Platyonychus*, *Actæodes*, *Scylla*). The antennulary tergum, on the other hand, seems to have disappeared entirely.

The sternum of the ophthalmic somite, considered by Dana to be wanting among the Brachyura, is present, as it appears to me, in what has hitherto been considered as a portion of the antennary somite and designated the antennary septum (compare Huxley, *loc. cit.*, p. 296, fig. 76, *c.*). In *Actæodes*, figs. 4, 6 and 7, the sternum of this somite is a distinct cuneiform body, wedged in between the rostrum and the antennary sternum, but separated from both by sutures.

Its connection is more intimate with the antennary sternum than with the rostrum. The basal joints of the antennæ lie in contact with it, since it helps to form the inner angle of both antennary orbits. This wedge-shaped body extends backward *into* the facial region and furnishes the calcareous sockets for the bases of the eye-stalks; but has *nothing to do* with the orbital region. This latter has arisen by the overgrowth of the rostral region (*i. e.*, forwards) which at the same time has been forced downward into the facial area. This growth is well illustrated in the series from *Homarus*, through *Lithodes*, *Platyonychus*, *Scylla* and *Cancer*, to *Actæodes.*

In *Cancer*, fig. 3, the connection of the ophthalmic with the antennulary sternum is still closer and the former is a much thinner plate. In *Scylla*, fig. 9, the rostrum is hardly in contact with the ophthalmic sternum, although it is bent down close over it. The suture between the ophthalmic and antennary sterna is obliterated. In *Platyonychus*, fig. 1, the fusion between the two sterna is complete. In *Palinurus*, figs. 14 and 16, *Lithodes*, fig. 11, and *Homarus*, fig. 5, the rostrum has not encroached upon the ophthalmic somite and the sternum sustains its normal relations to the appendages.

Antennulary sternum. The antennulary sternum in *Actæodes* is an elongated, bar-shaped plate extending across the facial area immediately below the antennæ. The antennules abut upon its ends, while the ophthalmic sternum is fused to its upper part dividing it into halves. The figure formed by these two plates is that of a short-stemmed T inverted. This plate forms the floor of the antennary sockets. The suture between the antennulary and the antennary sterna is lenticular in form and occupied by a semicalcified membrane.

In *Cancer*, fig. 3 and *Platyonychus*, fig. 1, the parts included in the facial area are much less distinct. In *Scylla*, fig. 9, this sternal plate lies opposed to the upper margin (surface) of the antennary sternum, in the form of a thin calcareous plate. Its relations to the surrounding parts are, however, the same as in *Actæodes*. In *Lithodes*, fig. 11, the antennulary sternum resembles in all respects the ophthalmic, and consists of a smooth, scarcely calcified membrane stretched between the antennules. In *Palinurus*, figs. 14 and 16, the antennulary sternum is enormously enlarged and projects forward in the form of a truncated pyramid, equivalent to the "nasal region" of Milne-Edwards. Owing to the unusually large size

of the antennæ, the antennules have their insertion at the anterior end of this plate instead of at the sides as would normally be the case. A narrow extension of the main (fold) plate separates the basal joint of the appendages. In *Homarus* this sternum is moderately developed and occupies its normal position. There is no indication among the Macroura or the Brachyura, of the existence of any other parts of the typical somite in either of these two segments.

Antennary and mandibulary somites. As regards the sterna of the third and fourth somites in *Chlorodius* and *Scylla*, I cannot do better than refer to Dana's admirable description (*loc. cit.*, pp. 24–28). This description of *Chlorodius* will apply in every particular to *Actæodes*, figs. 4, 6 and 7. In *Cancer* and *Platyonichus* the facial region is too much fused to admit of any accurate distinction of the parts. In *Palinurus* the antennary sternum is greatly enlarged and forms the lower part of the nasal projection. At its upper termination it furnishes the basal portion of the antennulary sockets: from this point it spreads out rapidly and extends entirely across the ventral surface of the body forming the anterior, lower one-third of the boundary of each antennary socket. The openings of the green glands are near to its outer angle, on the suture separating it from the mandibulary sternum. Its connections with the anterior half or cephalic portion of the carapax are very distinct and in the form of a beaded suture. The mandibular sternum is separated from the episternal pieces by a short suture, these latter in turn are separated from the epimerals by a suture passing backward and inward toward the median ventral line. In *Lithodes*, figs. 11 and 13, and *Homarus*, figs. 5 and 17, the episternals and epimerals of both antennary and mandibulary somites are present and consequently one is able to

trace the connection of the two portions of the carapax with comparative ease. The episternals and epimerals of the antennary segment are calcified. The former appear on either side of the epistome or sternum as an oblong plate extending backward, downward and outward and also furnish the upper plate of the entrance to the gill-chamber. The epimeral plate is folded inward close upon the episternum of either side and is only to be seen when the edges of the carapax are spread apart. The episterna and epimera of the mandibular segment are represented by slightly calcified membranes more or less folded upon themselves. These plates are related to the mandibular sternum in a manner similar to that stated for that of the corresponding plates of the preceding segment. In *Squilla* the antennary sternum is especially prominent and reaches backward and downward in the form of a half cylinder, the sides of which are formed by the large episternal plates. The carapax is almost entirely made up by the antennary tergum, and the antennary somite furnishes further, fully one-half of the length of the cephalo-thoracic region of the body of this crustacean. The statement that the terga of the thoracic somites are covered by the cephalo-thoracic shield is not strictly true. The first two terga (counting from behind forwards) are entire and free, the third is united by a membrane to the posterior edge of the cephalothorax. The remaining terga are incomplete and unite with the carapax in a line curving from the point of attachment of the third, outwards and forwards on either side of the median dorsal line of the body (fig. 21).

Sternal plates, etc. Milne-Edwards considers the small calcareous plates found at the base of the thoracic appendages, which in the adult state are more or less fused with the sterna of the respective segments, to be the homologues of the episternal pieces of the typical arthropod

somite. From embryological evidence it appears very probable that these pieces originate as simple projections of the outer posterior angle of each sternal plate and that they are apparently cut off by the appearance of false sutures at a later period of development. The figures illustrating this point (figs. 18, 19, 22) hardly need any explanation beyond that given in the description of the plates. A comparison of figs. 18 and 22 is conclusive.

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EXPLANATION OF PLATES II AND III.

REFERENCE LETTERS.

a antennule
a' antenna
as antennular sternum
a's antennal sternum
a't antennal tergum
a'tp plates of antennal tergum
ap appendage
e epimeral plate
e' epimeral groove
f labrum
g plate covering green gland
g' plate between antennule and carapax
m mandibular skeleton
mem membrane
ms mandibular sternum
mt mandibular tergum
mp anterior mandibular epimeral plate.
n membranous space
o eye or orbit
os ophthalmic sternum
pg processes for attachment of gastric muscles
r rostrum
s sternum
sp sternal piece
t tergum
tht thoracic tergum
y suture between mandibular and antennal sternum
x suture between epimeral and tergal plates of mandibular segment
z point of attachment of carapax to body

Fig. 1. Ventral view of carapax of an immature *Platyonichus ocellatus*, caustic soda, acetic acid preparation; natural size.

Fig. 2. Ventral view of the carapax of *Etisus dentatus;* natural size.

Fig. 3. Carapax of *Cancer borealis* prepared in caustic soda, ventral view with the front slightly inclined forwards; natural size.

Figs. 4, 6 and 7. Carapax of *Actæodes* species? prepared in caustic soda and acetic acid; viewed from above, below and in front, respectively.

Fig. 5. Front view of the carapax of *Homarus americanus* with the appendages removed, fresh specimen, natural size.

Fig. 8. Ventral view of the connection of the mandibular episternum with the mandibular epimeron in *Scylla tranquebarica;* natural size.

Fig. 9. Carapax of *Scylla tranquebarica* from an alcoholic specimen; natural size.

Fig. 10. Carapax of *Chlorodius floridanus*, alcoholic specimen; enlarged.

Figs. 11 and 13. Front and ventro-lateral views of the carapax of *Lithodes maia* alcoholic specimen; natural size.

Fig. 12. Basal joints of right antenna of *Homarus americanus* showing the position of the green gland; natural size.

Figs. 14, 16 and 20. Lateral, frontal and ventral views of the carapax of *Palinurus* prepared in caustic soda; natural size.

Fig. 15. Ventral view of young *Squilla*, the thorax and abdomen of which have been removed by careful dissection; *z* shows the point of attachment of the thorax; enlarged ten diameters.

Fig. 17. Lateral view of carapax of *Homarus americanus*, caustic soda preparation; natural size.

Fig. 18. Sternum of megalops of *Cancer borealis*, showing the episternal pieces as projecting angles of the sternal plates; enlarged ten diameters.

Fig. 19. Sternum of zoea of *Cancer;* enlarged fifteen diameters.

Fig. 21. Lateral view of a sagittal section of cephalo-thoracic region of *Squilla*, caustic soda preparation; natural size.

Fig. 22 Ventral view of sternum of *Cancer borealis* (prepared in caustic soda) showing the "episternal pieces" of Milne-Edwards; natural size.

Fig. 23. Ventral view of a young *Pinnixa*; enlarged ten diameters.

Annual Meeting, Monday, May 18, 1885.

The annual meeting this evening at 7.30 o'clock. The President in the chair. Records of the last annual meeting read and approved.

The reports of the Secretary, Treasurer, Auditor, Librarian, Curators and Committees were read and duly accepted and ordered to be placed upon file.

Mr. T. F. Hunt, chairman of the committee on nominations, reported the following list of officers, which was duly elected; Messrs. Israel and Upham having been appointed to collect, assort and count the votes.

PRESIDENT:

HENRY WHEATLAND.

VICE-PRESIDENTS:

Abner C. Goodell, Jr.
Frederick W. Putnam.
Daniel B. Hagar.
Robert S. Rantoul.

SECRETARY:

George M. Whipple.

TREASURER:

George D. Phippen.

AUDITOR:

Richard C. Manning.

LIBRARIAN:

William P. Upham.

CURATORS:

History—Henry F. Waters.
Manuscripts—William P. Upham.
Archæology—Frederick W. Putnam.
Numismatics—Matthew A. Stickney.
Geology—Benjamin F. McDaniel.
Botany—George D. Phippen.
Zoölogy—Edward S. Morse.
Horticulture—
Music—Joshua Phippen, Jr.
Painting & Sculpture—T. F. Hunt.
Technology—Edwin C. Bolles.

COMMITTEES:

Finance:

The President, *Chairman ex off.*
The Treasurer, *ex off.*
Geo. R. Emmerton.
David Pingree.
Henry M. Brooks.

Library:

Charles W. Palfray.
Henry F. King.
William Neilson.
William D. Northend.
Theodore M. Osborne.
The Librarian, *ex off.*

Publication:

Edward S. Atwood.
James A. Emmerton.
Edwin C. Bolles.
Henry F. Waters.
B. F. McDaniel.
T. F. Hunt.

Lecture:

Robert S. Rantoul.
Frederick W. Putnam.
Amos H. Johnson.
Fielder Israel.
A. L. Huntington.

Field Meeting:

The Secretary, *Chairman ex off.*

George A. Perkins, Salem.
George Cogswell, Bradford.
Francis H. Appleton, Peabody.
Nathaniel A. Horton, Salem.
E. S. Morse, Salem.
G. D. Phippen, Salem.
Frank R. Kimball, Salem.
Eben N. Walton, Salem.
Winfield S. Nevins, Salem.
John H. Sears, Salem.

THE RETROSPECT OF THE YEAR

compiled from the several reports read at the meeting and remarks of the members in relation thereto, presents the work of the Institute in the various departments since the last annual meeting.

MEMBERS.—Changes occur in the list of our associates by the addition of new names and the withdrawal of some by resignation, removal from the county or vicinity, or by death. We have received notice of the decease of nineteen, during the year, who have been enrolled on our list of members.

FRANCIS GREGORY SANBORN, son of Eastman and Mary Call Lawrence (Gregory) Sanborn, born in Andover, Mass., Jan. 18, 1838, a graduate of Phillips Academy, Andover, in 1858; he early turned his attention to outdoor studies, becoming especially proficient in entomology and conchology; he had been connected with the Massachusetts Board of Agriculture, the Bussey Institution, the Geological Survey of Kentucky, the Smithsonian Institution, and had been a Curator of the Worcester Natural History Society; died in Providence June 5, 1884. Admitted a member January 15, 1866.

JAMES B. BATCHELLER, for many years a teacher in the public schools of Salem and Marblehead, and for eighteen years a member of the School Committee in his native town. He was son of Rev. David Batcheller of Worcester, a methodist clergyman, and Elizabeth C. Bowler, of Marblehead, in which town he was born June 25, 1814; a graduate of Wesleyan University in 1845; professor of mathematics in Burlington, N. J.; died in Marblehead, July 1, 1884. Admitted a member Sept. 8, 1868.

David Brainerd Brooks, son of John and Harriet (Manning) Brooks, born in Salem, Aug. 7, 1824, died in Salem, July 9, 1884; bookseller and stationer in Salem and Boston. Admitted a member March 12, 1856. He began his business career in the bookstore of John P. Jewett, subsequently a partner, John P. Jewett & Co.

William Saunders, a well-known and distinguished veterinary surgeon for many years in Salem; his practice extending into Boston and the counties of Essex and Middlesex; son of William and Elizabeth (Britchers) Saunders, born in Helma, Devonshire, England, Nov. 27, 1817, came to Salem with his father in 1830, died in Salem, July 23, 1884. Elected to membership March 12, 1856.

Alfred Amos Abbott, son of Hon. Amos and Esther Mackey (West) Abbott, born in Andover, Mass., May 30, 1820; a graduate of Union College in 1841; lawyer in Peabody and Salem; for several years District Attorney and the clerk of the courts of Essex County from Sept. 27, 1870, to his decease. Died in Peabody, Oct. 27, 1884. Elected to membership Dec. 30, 1867.

William H. Palmer, son of Asa and Mary (Fletcher) Palmer, born in New Hampshire, March 9, 1811; trader in Salem, Mass.; died Oct. 29, 1884. Elected to membership Feb. 4, 1863.

Isaac J. Osbun, son of Franklin and Mary E. (Taylor) Osbun, born in Windsor, Richland county, Ohio, May 19, 1850; graduated at Granville College, Ohio, 1872; after keeping school one year he sailed for Europe and spent one year in the University of Tubingen and the next year at Heidelberg where he studied chemistry and physics under the famous Robert Wilhelm Bunsen. In

1875 he returned to this country; from 1876-83 was teacher in chemistry and physics in the Mass. State Normal School in Salem; he then entered upon the duties of Professor of Chemistry and Physics in Denison University, Granville, Ohio, and continued his labors there until a few weeks previous to his death which occurred Dec. 8, 1884. Elected to membership July 2, 1877.

Esther Clarke Mack, daughter of Elisha and Harriet (Clarke) Mack, born in Worthington, Mass., Sept. 25, 1821. The family returned to Salem in 1827. Died in Salem, Dec. 24, 1884. Admitted to membership Dec. 5, 1882.

Edward B. Ames, son of Burpee and Hannah (Brown) Ames, born in Salem, March 4, 1815; a well known citizen, senior member of the firm of Ames and Melcher, painters in Salem, having been in business upwards of forty years; died January 15, 1885. Admitted to membership March 29, 1854.

Nathaniel B. Perkins, son of Joseph Perkins, born in Salem, Oct. 3, 1813; for many years cashier of the Merchants National Bank, Salem; died Feb. 8, 1885. Admitted to membership Dec. 14, 1853.

Aaron Goldthwaite, son of Aaron Goldthwaite, born in Salem, March 9, 1822; of the well-known firm of Goldthwaite & Day, carpenters and contractors; died in Salem, Feb. 11, 1885. Admitted to membership Feb. 15, 1854.

Lemuel B. Hatch, the well-known coal and wood dealer, for more than forty years on Derby street; died March 1, 1885; he was the son of James and Opal (Bonney) Hatch; born in Hanson, Mass., Sept. 1, 1806. Admitted to membership March 1, 1869.

Elizabeth B. Perkins, daughter of Edward B. and Elizabeth P. (Barrett) Perkins, born in Salem, Jan. 1, 1850, died April 8, 1885. Admitted to membership March 21, 1881.

George Leeds, son of Benjamin Bass and Sally (Babcock) Leeds; born in Boston, Oct. 25, 1816; fitted for college at Milton Academy, graduated at Amherst College, 1835, Andover Theological School, 1839; rector of Grace Church, Utica, N. Y.; St. Peter's, Salem; St. Peter's, Philadelphia, and Grace Church, Baltimore; D.D. Trinity College, 1861; died, in Philadelphia, of apoplexy, April 16, 1885. Admitted to membership Feb. 28, 1855.

John Chapman Towne, son of Joseph and Lydia (Chapman) Towne, born at Salem, June 16, 1834; in early life a printer in the office of the Salem Register, afterwards, for many years, teller in the Naumkeag National Bank, Salem; died April 23, 1885. Admitted to membership July 1, 1863.

Leonard Withington, son of Joseph Weeks and Elizabeth (White) Withington, born in Dorchester, Mass., Aug. 9, 1789; a graduate of Yale College, 1814; ordained over the First Church in Newbury, Mass., Oct. 30, 1816, and continued the active pastor of that church 42 years, when he became senior Pastor; died Apr. 22, 1885. Original member.

George Pickman Farrington, the oldest druggist in Salem, son of William and Mary (Ward) Farrington, born in Salem, Aug. 29, 1808; died April 29, 1885. Admitted to membership June 9, 1864.

Charles Eugene Fabens, son of Charles Henry and Euphrasia (Fabens) Fabens, born in Cayenne, S. A., March 27, 1845; merchant in Salem and Boston, residing

in Salem, where he died Jan. 22, 1885. Admitted to membership Feb. 20, 1871.

Field Meetings have been attended with more than usual interest.

The first on Wednesday June 18, 1884, at Topsfield, in commemoration of a meeting held for the completion of the organization of the Essex County Natural History Society, fifty years ago, in that town; its location in the geographical centre of the county, before the introduction of railroads, was considered a very suitable and convenient place for the holding of conventions and other gatherings, possessing a general county interest. The morning was passed at the residence of Mr. Thomas W. Peirce, whose extensive grounds, fine gardens and conservatories were opened to the visitors. The afternoon session in the Town Hall was largely attended; the speakers were the President and Messrs. E. S. Morse, John Robinson, B. F. McDaniel, S. P. Fowler and J. J. H. Gregory. The progress made in Zoölogy, Botany, Geology and the kindred branches of science since 1834, especially with reference to the increasing attention devoted to these studies, in this county was fully discussed. Mr. Fowler, who was present at the meeting fifty years since, gave an account of the gathering and spoke of those who were present, all of whom, with a few exceptions, have passed away.

Second Meeting at Annisquam, Gloucester, Wednesday, July 16, 1884. The morning was spent at the seaside Laboratory of Prof. Alpheus Hyatt in observing the work of the students, also in visiting the beaches and other objects of interest. At the afternoon session remarks were offered by the president, Messrs. Kingsley and Hyatt of the Laboratory giving a full account of the methods of instruction. Mr. James S. Jewett, Hon. Jonas H. French

and Hon. James Davis, mentioned interesting incidents in the History of Annisquam. Mr. A. C. Perkins of Brooklyn, N. Y., and N. A. Horton of Salem, also addressed the meeting.

Third, at Asbury Grove, Hamilton, Thursday, July 31, 1884, postponed from the preceding day on account of the weather. In the forenoon a botanical excursion was made to Pleasant Pond under the direction of Mr. Sears. At the meeting in the afternoon, the president and Messrs J. F. Almy, John H. Sears, George D. Phippen, F. W. Putnam, B. F. McDaniel and N. A. Horton were the speakers.

Fourth, at old Newbury on Thursday, August 28, 1884. In the morning the party went to Plum Island and on the return visited the ethnological collections of Mr. Alfred Osgood, also several of the old houses in Newbury and Newburyport. The afternoon session was held in the vestry of the First Church. The President after a few introductory remarks called upon Capt. Luther Dame who read a paper on the life and times of Sir William Pepperell, exhibiting several original manuscripts and old family relics; Alfred Osgood spoke on ethnology; Stephen H. Phillips took for his subject, the early settlers of Newbury; Rev. B. F. McDaniel spoke on the mineralogy of Newbury; Rev. Messrs. F. Israel of Salem, and George Osgood of Kensington, N. H., alluded to the Rev. Dr. Withington, for nearly seventy years, the worthy and beloved pastor of this church and this people; Mr. D. B. Hagar made some closing remarks and offered a vote of thanks for favors received.

Two Geological Excursions, a sequel to the Field Meetings, have taken place under the direction of Rev. B. F. McDaniel, the curator of this department.

First, on Monday, Oct. 13, 1884, to the famous locality

in Newbury oldtown popularly known as "the Devil's Den." For over forty years it has been visited by mineralogists for the fine specimens that have made it famous all over the country, and still the supply is abundant. Other openings have been made near by, the most noted of which is the "Basin."

Specimens of the following minerals, some of them very fine, were brought home. Noble serpentine, common serpentine, retinalite, wollastonite, chrysolite, massive garnet, nemalite, calcite, chalybite and dolomite. The noble serpentine and wollastonite are easily obtained, and are very fine at the "Den," while at the "Basin," the common serpentine and retinalite abound.

Second, on Monday, Nov. 10, 1884, to the Quarry near Lynnfield Centre. A stop was made at Ship Rock in Peabody, after which the drive was continued to Lynnfield. The Quarry was reached at half-past eleven o'clock. Hammers and drills were soon in use and good specimens of brucite and serpentine were found in abundance. An increased interest in the study of geology has been awakened, and the result will probably be an interesting addition to the already large collection of Essex County Minerals in the Museum.

MEETINGS. Regular meetings occur on the first and third Monday evenings of each month. At these the following communications were read and lectures delivered:

From *E. A. Silsbee*, talk upon "Criticism of Poetry."

Stephen H. Phillips, "Witchcraft not exceptional in Salem."

Charles A. Benjamin, "On an adjacent Peninsula."

A. C. Hobbs of Bridgeport, Conn., lecture "On the History of Locks."

William G. Barton of Salem, essay on "Thoreau, Flagg and Burroughs."

Percival Lowell of Boston, an illustrated lecture "On Korea" (a native Korean was present on the stage, in national costume).

Edward Atkinson of Boston, a familiar talk upon the subject "Lack of Gumption."

John H. Sears, Flowering of plants, December, 1884.

W. J. Hoffman of Washington, D. C., "Hugo Ried's account of the Indians of Los Angeles, California, with notes by W. J. Hoffman."

William L. Welch, "Opening of Hatteras Inlet."

Oliver Thayer, "Early recollections of the upper portion of Essex Street, Salem."

Robert S. Rantoul, "Some material for a History of the Name and Family of Rentoul, Rintoul, Rantoul."

E. P. Crowell of Amherst, "The commission of the Captain of a Salem Privateer, in the Revolutionary war."

In addition to the lectures and communications presented at the meetings the following lectures have been delivered in the rooms of the Institute.

LECTURES. *Mrs. Schumacher* of Boston, an illustrated lecture "On the Madonna in Art," Tuesday, Nov. 11, 1884.

C. D. Hendrickson, an illustrated lecture "On the wonderland of America, the Yellowstone National Park," Monday, Dec. 8, 1884.

Edward S. Morse, six lectures on Japan and the Japanese, on Wednesdays, Dec. 17, 24, 31, 1884 and Jan. 7, 14, 21, 1885.

Mrs. Abby Sage Richardson, three lectures: first "Robert and Elizabeth (Barrett) Browning," Wednesday, Apr. 22, 1885; second, "Sir Walter Scott," Wednesday, Apr. 29; third, "The modern Spirit of Poetry," Wednesday, May 6.

Library.—The additions to the Library for the year (May, 1884, to May, 1885) have been as follows:

By Donation.

Folios,	13
Quartos,	263
Octavos,	1,531
Duodecimos,	543
Sexdecimos,	264
Octodecimos,	66
Total of bound volumes,	2,680
Pamphlets and serials,	11,635
Total of donations,	14,315

By Exchange.

Folios,	1
Quartos,	10
Octavos,	188
Duodecimos,	15
Total of bound volumes,	214
Pamphlets and serials,	2,483
Total of exchanges,	2,697

By Purchase.

Folios,	1
Quartos,	5
Octavos,	117
Duodecimos,	191
Sexdecimos,	60
Octodecimos,	6
Total of bound volumes,	380
Pamphlets,	7
Total of purchases,	387
Total of donations,	14,315
Total of exchanges,	2,697
Total of purchases,	387
Total of additions,	17,399

Of the total number of pamphlets and serials, 5,072 were pamphlets, and 9,053 were serials.

The donations to the Library for the year have been received from one hundred and seventy individuals and forty-six societies and governmental departments. The

exchanges from seven individuals and from one hundred and fifty-five societies and incorporate institutions, of which seventy-nine are foreign; also from editors and publishers.

The annual examination of the Library has been made and it is found to be in as good order and condition as our limited resources permit.

The accessions have been more numerous than for many years. Among what may be termed the customary donations may be classed the Congressional Record, documents, etc., from E. F. Stone representative U. S. Congress; congressional documents from the Department of the Interior, and others from the various departments of the government; Mass. State documents from the General Court Representatives; agricultural papers from the secretary of the Mass. Horticultural Society; the transactions of various societies; besides books and pamphlets in smaller or larger quantities from the members and others, a list of too great length to be read at this time.

Among special donations may be mentioned:—From Geo. R. Lord, a portion of the library of the late Nathl. Lord, amounting to 470 vols., and 2,384 pamphlets; among the latter, religious periodicals hold a prominent place. From the library of the late William Sutton, 1,319 vols., and 1,558 pamphlets, a donation very valuable in historical works and state documents. A collection of pamphlets from the estate of Robert and Elizabeth R. Peele. A nearly complete file of the Salem Register and 1,039 numbers of religious magazines from Chas. M. Richardson. Harper's Magazine and other periodicals to the number of 289 from Jas. A. Chamberlain. From the estate of Mrs. Martha P. Walcott, 95 vols., and 665 pamphlets, including periodicals. 67 volumes of scientific works from Mrs. Wm. S. Cleveland. From Mrs. M. C.

Farley, 48 vols., chiefly state and government documents. A large number of religious works and pamphlets from Rev. Hugh Elder. Some very valuable school books from Miss Elizabeth Lander. From Sam'l Chamberlain, besides volumes, religious and educational periodicals. Thirty religious works from Capt. George Upton. From Dr. William Mack an addition to the musical library as well as to other departments.

The Art Library is constantly receiving very valuable accessions of volumes and periodicals.

Our most excellent and efficient Assistant Librarian, whose usefulness we all recognize, has especially called my attention to the pressing necessity of more room. Almost every department is receiving from time to time, additions of more or less magnitude, and all are crowded to overflowing; there is scarcely a case where a proper arrangement of volumes or pamphlets can be made, on account of the limited room. One deep shelf has three rows of books; a case of newspapers has the space in the centre occupied with books piled up in bulk, and no access to them without removing the tier of papers in front; one can easily imagine the labor of finding a specified book of that lot.

The space reserved for the exchanges of foreign societies has for some time been filled to repletion.

A portion of our recent donations has been accommodated by putting up temporary shelves in the ante-room occupied by the historical museum. This, however, separates them from other books of the same class in the general library. Others are piled in bulk on the gallery floor, preventing their circulation and making them nearly inaccessible for reference.

The two cases at the rear of the lower hall have already double rows of directories on nearly every shelf.

From this statement of facts it can readily be seen how urgent is the need of greater accommodations and additional shelf-room.

Respectfully submitted,
WM. P. UPHAM,
Librarian.

Donations or exchanges have been received from the following:

	Vols.	Pam.
Adams, Miss Hannah C., Beverly,	11	
Adelaide, Royal Society of South Australia,		1
Agassiz, Alexander, Cambridge,		1
Albany, N. Y., State Library,	8	5
Alnwick, Eng., Berwickshire Naturalists' Club,		1
Altenburg, Naturforschende Gesellschaft des Osterlandes,		2
American Association for the Advancement of Science,	1	
American Ornithologists' Union,		4
Amherst College Library,		1
Anagnos, M., South Boston,		1
Andover Theological Seminary,		1
Andrews, William P.,		49
Archaeological Institute of America,	1	1
Archer, Miss Rebecca, ... Newspapers,		
Auckland, N. Z., Auckland Institute,	1	
Baltimore, Md., Historical Society,	2	1
Baltimore, Md., Johns Hopkins University,		8
Baltimore, Md., Johns Hopkins University, Library of Historical and Political Science,		9
Baltimore, Md., Peabody Institute,		1
Bamberg, Naturforschende Gesellschaft,		1
Bancroft, Rev. C. F. P., Andover,		1
Batavia, K. Natuurkundige Vereeniging,	1	
Bayley, Miss Elizabeth S.,	15	
Bayley, Miss Harriet K., Boston,		17
Belfast, Ireland, Naturalists' Field Club,		1
Bell, Charles H., Exeter, N. H.,	1	2
Berkeley, Cal., University of California,		27
Berlin, Gesellschaft Naturforschender Freunde,		1
Berlin, Verein zur Beförderung des Gartenbaues,		52
Bern, Naturforschende Gesellschaft,		5

	Vols.	Pam.
Blake, Francis E., Boston,		1
Bolles, Rev. E. C., D.D.,	7	397
Bonn, Naturhistorischer Verein,		2
Boston, American Academy of Arts and Sciences,		2
Boston, Appalachian Mountain Club,		2
Boston Board of Health,		12
Boston, Bostonian Society,		2
Boston, City of,	4	
Boston City Hospital,	1	1
Boston, Massachusetts General Hospital,		1
Boston, Massachusetts Historical Society,	2	
Boston, Massachusetts Horticultural Society,		3
Boston, Massachusetts Medical Society,		2
Boston, Massachusetts State Board of Health, Lunacy and Charity,	1	
Boston, Massachusetts State Library,	1	
Boston, National Association of Wool Manufacturers,		4
Boston, New England Historic, Genealogical Society,		5
Boston Overseers of the Poor,	1	
Boston Public Library,		3
Boston Scientific Society,		3
Boston Society of Natural History,		19
Boylston, E. D., Amherst,		1
Bradlee, Rev. C. D., Boston,		1
Bremen, Naturwissenschaftlicher Verein,		2
Bristol, Eng., Naturalists' Society,		2
Brooklyn, N. Y., Brooklyn Library,		5
Brown, Henry A.,	3	117
Browne, Albert G., ... Newspapers,		1
Brunswick, Me., Bowdoin College Library,		1
Bruxelles, Société Belge de Microscopie,	1	9
Bryant, James S., Hartford, Conn.,	2	
Buenos Aires, Sociedad Cientifica Argentina,	1	14
Buffalo, N. Y., Historical Society,	1	2
Buffalo, N. Y., Young Men's Association,		2
Caen, Académie des Sciences, Arts et Belles Lettres,		1
Calcutta, Geological Survey of India,		16
Cambridge, Harvard University Library,	1	4
Cambridge, Museum of Comparative Zoölogy,		8
Cambridge, Peabody Museum of American Archæology and Ethnology,	1	
Canada Royal Society,	1	
Cannon, H. W., Washington, D. C.,	1	

		Vols.	Pam.
Carpenter, Rev. C. C., Mt. Vernon, N. H.,			1
Cassel, Verein für Naturkunde,			1
Chamberlain, James A.,			289
Chamberlain, Samuel,		12	335
Champaign, Ill., State Laboratory of Natural History,			1
Chever, Miss S. A., Melrose,		1	
Chicago, Ill., Historical Society,		1	1
Chicago, Ill., Public Library,			1
Cincinnati, O., Society of Natural History,			4
Clarke, Rev. DeWitt S.,			1
Cleveland, Mrs. William S.,		67	
Cogswell, George, Bradford,		1	1
Cole, Mrs. N. D.,	Newspapers,		64
Collett, John, Indianapolis, Ind.,		2	
Conant, W. P., Washington, D. C.,	Newspapers,	2	68
Coolidge, Henry J., Boston,		1	8
Copenhague, Société Botanique,			5
Cordoba, Académie Nacional de Ciencias,			3
Courtenay, William A., Charleston, S. C.,		1	
Cowley, Charles, Lowell,			2
Cox, William R., Washington, D. C.,			3
Crowell, Rev. E. P., D.D., Amherst,		1	
Crunden, F. M., St. Louis, Mo.,			2
Currier, John M., Castleton, Vt.,			1
Cushing, Thomas, Boston,		1	
Cutter, A. E. Charlestown,			1
Danzig, Naturforschende Gesellschaft,			1
Darmstadt, Verein für Erdkunde,			1
Davenport, Ia., Academy of Natural Sciences,			1
Davis, Charles H. S., Meriden, Conn.,			1
Davis, James, Gloucester,		1	
Davis, R. S., & Co., Pittsburgh, Pa.,		1	
Dennett, W. S., Saco, Me.,			1
Denver, Colorado Scientific Society,			1
Dewing, Miss Mary E.,		1	2
Donnell, E. J., New York, N. Y.,			1
Doolittle, Miss E., Troy, N. Y.,			1
Dresden, Naturwissenschaftliche Gesellschaft, "Isis,"			2
Dublin, Royal Irish Academy,			5
Dublin, Royal Society,		1	13
Durkheim, Pollichia, Naturwissenschaftlicher Verein der Rheinpfalz,			4
Eaton, Mrs. C. F.,		11	58

	Vols.	Pam.
Eddy, Robert H., Boston, ...		1
Edinburgh, Royal Society, ...	2	
Elder, Rev. Hugh, ...	20	225
Ellery, Harrison, Chelsea, ...		1
Emden, Naturforschende Gesellschaft, ...		1
Emmerton, James A., ...	1	14
Erfurt, K. Akademie gemeinnütziger Wissenschaften, .		1
Erlangen, Physikalisch-medicinische Societät, . .		1
Essex, Eng., Essex Field Club, ...		2
Falmouth, Eng., Royal Cornwall Polytechnic Society, .		1
Farley, Misses, ...		1
Farley, Mrs. M. C., ...	48	
Fewkes, J. Walter, Cambridge, ...		2
Folger, William C., Nantucket, ...		2
Folsam, A. A., Boston, ...		9
Folwell, William W., Minneapolis, Minn., ...		1
Foote & Horton, ... Newspapers,		
Forbes, S. A., Champaign, Ill., ...		3
Francisco, Miss M. A., ...	12	
Frankfurt, Senckenbergische Naturforschende Gesellschaft, ...	1	1
Freiburg, Naturforschende Gesellschaft, ...		1
French, A. D. Weld, Boston, ...	1	
Frothingham, T. G., Boston, ...		1
Garman, Samuel, Cambridge, ...		1
Genève, L'Institut National Genèvois, ...	2	
Giessen, Oberhessische Gesellschaft für Natur. u. Heilkunde, ...		1
Good, Peter B., Plainfield, N. J., ...	1	
Goodell, Mrs. A. C., Jr., ... Newspapers,		52
Görlitz, Naturforschende Gesellschaft, ...	1	
Green, Samuel A., Boston, ...	18	580
Greenough, James C., Amherst, ...		1
Guss, A. L., Washington, D. C., ...		2
Guthrie, Malcolm, Liverpool, Eng., ...	1	
Halifax, Nova Scotian Institute of Natural Science, .		1
Halle, K. Leopoldinisch—Carolinische deutsche Akademie der Naturforscher, ...		7
Halle, Naturwissenschaftlicher Verein für Sachsen u. Thüringen, ...		1
Hamburg, Naturwissenschaftlicher Verein, ...		3
Hamburg, Verein für Naturwissenschaftliche Unterhaltung, ...		1

	Vols.	Pam.
Hamilton, R. I., Narragansett Historical Publishing Company, ...		4
Harlem, Société Hollandaise des Sciences, . . .		6
Hartford, Conn., Trinity College, ...		1
Hassam, John T., Boston, ...	1	
Hill & Nevins, ...		23
Hitchcock, E., Amherst, ...		8
Hobarton, Royal Society of Tasmania, ...	1	2
Howard, George E., Lincoln, Neb., ...		1
Hunt, T. F., ...	77	278
Huntoon, D. T. V., Canton, ...		2
Illinois Department of Agriculture, ...	6	6
Iowa City, Ia., State Historical Society, . . .		1
Ipswich, Town of, ...	1	
Israel, Rev. Fielder, ... Newspapers,		13
James, U. P., Cincinnati, O , ...		2
Kato, H., Tokio, Japan, ...		4
Kimball, Mrs. James, ...		2
Kingsley, J. S., Malden, ...		7
Kjöbenhavn, K. D. Videnskabernes Selskab, . . .		2
Königsberg, Physikalisch-ökonomische Gesellschaft, .		2
Lander, Miss Elizabeth, ...	45	43
Langworthy, Rev. I. P., Boston, ...		37
Lansing, Mich., Secretary of the State Board of Agriculture, ...	1	
Lansing, Mich., State Agricultural College, . . .	2	1
Lansing, Mich., State Library, ...	16	7
Lausanne, Société Vaudoise des Sciences, . . .		2
Lawrence, George N., New York, N. Y., . . .		3
Lawrence Public Library, ...		2
Lawrence, William, Washington, D. C., . . .	1	
Lee, F. H., ...	2	446
Leeds, Josiah W., Philadelphia, Pa., ...	1	
Leeds, Philosophical and Literary Society, . . .		1
Le Mans, Société d'Agriculture Sciences et Arts de la Sarthe, ...		2
Liège, Société Royale des Sciences, ...		1
Lincoln Library Trustees, ...		1
Littlefield, George E., Boston, ...	25	
Locke, Silas M., ...	1	
London, Eng., Conchological Society, ...		3
London, Eng., Royal Society, ...		6
Lord, George R., ...	470	2384

	Vols.	Pam.
Lovell, W. H., Worcester, ...		1
Lowell, Old Residents' Association, ...		1
Lüneburg, Naturwissenschaftlicher Verein, . . .		1
Luxembourg, L'Institut Royal Grand Ducal, . . .	1	
Lyon, L'Académie des Sciences, Arts et Belles Lettres, .	1	
Mack, William, ...	46	210
Madison, Wis., State Historical Society, ...	1	3
Madrid, Sociedad Española de Historia Natural, . .		4
Manchester, Eng., Literary and Philosophical Society, .	2	3
Manchester, Rev. L. C., Lowell, ...		75
Manning, Miss Rebecca, ...	1	
Manning, Robert, ... Newspapers,		72
Marietta, O., Marietta College, ...		7
McDaniel, Rev. B. F., ...	12	29
Meek, Henry M., ...	2	
Melcher, B. Redford, Saco, Me., ...		1
Meriam, H. C., ...	1	
Merrill, William, Jr., West Newbury, ...		1
Mexico, Museo Nacional, ...		1
Milwaukee, Wis., City Public Museum, ...		4
Montreal, Natural History Society, ...		1
Morse, E. S., ...		221
Münster, Westfälische Provinzial Verein, ...		1
Murdock, J. B., Philadelphia, Pa., ...		1
Nashville, Tennessee Historical Society, ...		1
Neuchâtel, Société des Sciences Naturelles, . . .	1	
Nevins, W. S., ... Newspapers,		
Newark, New Jersey Historical Society, ...	1	3
New Haven, Conn., Academy of Arts and Sciences, .		1
New Haven, Conn., N. H. Colony Historical Society, .		2
New Haven, Conn., Yale College Library, . . .		3
New York, N. Y., Academy of Sciences, . . .		2
New York, N. Y., American Geographical Society, .		6
New York, N. Y., Astor Library, ...		1
New York, N. Y., Chamber of Commerce, . . .		1
New York, N. Y., Genealogical and Biographical Society,		4
New York, N. Y., Linnaean Society, ...	1	
New York, N. Y., Mercantile Library Association, .		3
New York, N. Y., Microscopical Society, ...		4
Nichols, Andrew, Jr., Danvers, ...		5
Northampton, Smith College, ...		1
Northend, William D., ...	5	44
Norwegian North Atlantic Expedition, Editorial Committee, ...		1

	Vols.	Pam.
Nourse, Miss Dorcas C., ...		2
Noyes, S. B., Brooklyn, N. Y., ...	1	
Oliver, H. K., ...	4	50
Osgood, John C., ... Newspapers,		
Ottawa, Geological and Natural History Survey, . .		7
Packard, A. S., Providence, R. I., ...		1
Page, Miss Annie L., Danvers, . . Newspapers,		
Palfray, C. W., ...	3	270
Paris, Société d'Acclimatation, ...		12
Paris, Société d'Anthropologie, ...		3
Patch, Ira J., ...	10	
Peaslee, John B., Cincinnati, O., ...	1	1
Peele, Robert, Peele, Elizabeth R., } Estate of the late, . . .	2	148
Peet, Rev. S. D., Clinton, Wis., ...		6
Peirce, Henry B., Boston, ...	8	
Perkins, George A., ...		12
Perley, Sidney, Boxford, ...		2
Perry, Rev. William Stevens, Davenport, Ia., . .		1
Philadelphia, Pa., Academy of Natural Sciences, . .		29
Philadelphia, Pa., American Philosophical Society, .		8
Philadelphia, Pa., Historical Society of Pennsylvania, .		3
Philadelphia, Pa., Library Company, ...		2
Philadelphia, Pa., Numismatic and Antiquarian Society, .		1
Philadelphia, Pa , Zoölogical Society, ...		2
Phillips, Henry, Jr., Philadelphia, Pa., ...		2
Phillips, Stephen H., ...		3
Phillips, Mrs. Stephen H., ...		7
Pickering, Miss Mary O., . . . Newspapers,	6	25
Pool, Wellington, Wenham, ...		3
Porter, Rev. E. G., Lexington, ...		1
Poughkeepsie, N. Y., Vassar Brothers' Institute, .		1
Providence, Rhode Island Historical Society, . . .	1	1
Providence, R. I., Public Library, ...		9
Putnam, Rev. A. P., D.D., Brooklyn, N. Y., . . .		3
Putnam, F. W., Cambridge, . . Newspapers,		20
Putnam, H. W., ...	61	33
Rantoul, R. S., ... Newspapers,	30	197
Reeve, J. T., Appleton, Wis., . . Circular,		
Regensburg, K. Baierische Botanische Gesellschaft, .	1	
Regensburg, Naturwissenschaftlicher Verein, . .		1
Rice, Franklin P., Worcester, ...		1
Richardson, Charles M., ... Newspapers,	1	1039
Richardson, F. P., ...		6

		Vols.	Pam.
Richmond, Virginia Historical Society,		2	
Riga, Naturforschender Verein,			1
Robinson, John,			1
Robinson, Mrs. John,			35
Sale, John, Chelsea,		1	
Salem, Peabody Academy of Science,	Newspapers,	5	380
Sampson, Davenport & Co., Boston,		96	
San Francisco, California Academy of Sciences,			2
San Francisco, Cal., Mercantile Library Association,			1
Sargent, Charles S., Brookline,			1
Sawyer, Samuel E., Gloucester,			1
Scudder, S. H., Cambridge,			1
S'Gravenhage, Nederlandsche Entomologische Vereeniging,			5
Shanghai, China Branch of the Royal Asiatic Society,			1
Sillars, Walter A., Danvers,			26
Smith, George Plumer, Philadelphia, Pa.,		5	2
Snell, Miss Annie E.,	Newspapers,		
Springfield, City Library Association,			1
Springfield, Mo., Drury College,			3
Stickney, George A. D.,		8	10
St. John, New Brunswick Natural History Society,			1
St. Louis, Mo., Academy of Science,			1
St. Louis, Mo., Historical Society,			1
St. Louis, Mo., Public School Library,			1
Stockholm, Entomologiska Föreningen,			3
Stockin, A. C., Boston,		1	
Stone, A. R.,	Maps,		
Stone, E. F., Washington, D. C.,		9	147
Stone, Miss Mary H.,			30
Stone, Robert,	Newspapers,		
Story, Miss E. A.,			1
St. Paul, Minnesota Historical Society,		1	1
St. Pétersbourg, Académie Impériale des Sciences,			31
St. Petersburg, Imperial Botanical Garden,			2
St. Petersburg, Societas Entomologica Rossica,			1
Sutton, William, Estate of the late,		1319	1558
Sydney, Royal Society of New South Wales,		2	
Tasmania Government Statistician,		1	
Taunton, Eng., Somersetshire Archæological and Natural History Society,		1	
Taunton Public Library,			2
Titus, Rev. Anson, Amesbury,			1

		Vols.	Pam.
Tokio, Japan, Tokio Daigaku,			1
Topeka, Kan., State Board of Agriculture,		1	
Topeka, Kan., State Historical Society,			1
Topeka, Kan., Washburn College,			1
Toronto, Canadian Institute,			3
Tuckerman, L. S.,			52
Unknown,		8	16
Upham, William P.,		1	1
Upsal, Société Royale des Sciences,			1
Upton, George,		30	
Upton, Winslow, Providence, R. I.,			1
Urbano, O., Central Ohio Scientific Association,			1
U. S. Bureau of Education,		1	10
U. S. Chief of Engineers,	Maps,	8	2
U. S. Chief Signal Office,		2	1
U. S. Coast and Geodetic Survey,		1	
U. S. Department of Agriculture,		2	
U. S. Department of the Interior,		66	2
U. S. Department of State,		3	11
U. S. Fish Commission,		1	
U. S. Geological Survey,		6	5
U. S. Life Saving Service,		1	
U. S. National Museum,			39
U. S. Naval Observatory,		1	1
U. S. Patent Office,		3	56
U. S. Postmaster General,		2	
U. S. Treasury Department,		1	
U. S. War Department,		3	
Vose, George L., Boston,			1
Wagner, E. C., Girardville, Pa.,			8
Walcott, Mrs. Martha P., Estate of the late,		95	665
Waring, George E., Jr., Newport, R. I.,			2
Washington, D. C., Bureau of Ethnology,		2	
Washington, D. C., Smithsonian Institution,		5	
Waters, J. Linton,			15
Waters, Misses,		5	
Waters, Stanley,			26
Waterville, Me., Colby University,			1
Watson, S. M., Portland, Me.,			6
Weston, Charles H.,		19	
Wheatland, Miss M. G.,		1	
Whipple, George M.,		1	1
Whipple, S. K., Newburyport,		1	4

		Vols.	Pam.
Whitcher, Mary, Shaker Village, N. H.,			13
Whitney, Mrs. H. M., Lawrence,	Newspapers,		54
Whittier, Daniel B., Boston,	Chart,		1
Whittredge, Charles E.,			1
Wien, K. K., Zoologisch-botanische Gesellschaft,		1	1
Wien, Verein zur Verbreitung Naturwissenschaftlicher Kenntnisse,		1	
Wiesbaden, Nassauischer Verein,		1	
Wilder, Marshall P., Boston,		4	
Willson, Rev. E. B.,		21	420
Winchell, N. H., Minneapolis, Minn.,		2	2
Winnipeg, Manitoba Historical and Scientific Society,			6
Winsor, Justin, Cambridge,			34
Winthrop, Robert C., Boston,			1
Woods, Mrs. Kate T.,		2	171
Worcester, American Antiquarian Society,			2
Wright, Harrison, Wilkes-Barre, Pa.,			3
Würzburg, Physikalisch-Medicinische Gesellschaft,		1	2

The following have been received from editors or publishers :—

American Journal of Science.
Bay State Monthly.
Cape Ann Bulletin.
Chicago Journal of Commerce.
Danvers Mirror.
Essex Co. Statesman.
Fireside Favorite.
Gardener's Monthly and Horticulturist.
Groton Landmark.
Ipswich Chronicle.
Lawrence American.
Lynn Bee.
Manifesto, The.
Marblehead Messenger.
Musical Herald.
Musical Record.
Nation, The.
Naturalists' Leisure Hour and Monthly Bulletin.
Nature.
Newton Transcript.
New York Chamber of Commerce Journal.
Our Dumb Animals.
Peabody Press.
Quaritch's Catalogue.
Sailors' Magazine and Seamen's Friend.
Salem Evening News.
Salem Evening Telegram.
Salem Gazette.
Salem Observer.
Salem Register.
Turner's Public Spirit.
Voice, The.
West Newbury Messenger.
Zoologischer Anzeiger.

HORTICULTURAL. The Trustees of the Essex Agricultural Society having accepted, for the second time, the invi-

tation of the authorities and citizens of Salem to hold their Annual Cattle Show and Fair at the "Willows" in Salem, Sept. 23 and 24, 1884, the Institute deemed it advisable to suspend its own horticultural exhibition and to unite cordially with the Trustees of the Agricultural Society in making their undertaking a success.

An account of the Exhibition will be found in the Transactions of the Agricultural Society for the year 1884.

MUSEUM. The specimens in natural history, including those in archæology, which have been received during the year have been placed on deposit with the Trustees of the Peabody Academy of Science, in accordance with previous arrangements. Those of an historical character, or which possess an artistic interest, have been placed in the rooms, and have been received from the following contributors:

The Peabody Academy of Science, Tennessee Historical Society, Miss Mary O. Pickering, Miss E. A. Story, Edwin N. Peabody, Dr. Wm. Mack, Miss C. Roberts of Philadelphia, Mr. Nathan Pierce, Miss Lizzie C. Ward of Boston (this donation is a crayon portrait of her brother, Gen. Fred Ward of Salem, who was killed in China in 1861, having risen to a high rank in the Chinese army; the portrait is neatly framed and now hangs in the western ante-room of Plummer Hall;) William R. Cloutman, E. S. Bowditch, R. S. Rantoul, Geo. M. Whipple, Geo. L. Ames, W. A. Keazar, Miss M. A. Francisco, E. N. Larrabee, T. F. Hunt, B. D. Hill and Amos Henfield.

THE ART EXHIBITION opened on Thursday, May 15, 1884, and closed on the 24th inst., the eighth under the auspices of the Institute. These exhibitions of Essex County work, vary in interest with each passing year.

The collection was smaller than that of the preceding, and the paintings of Benson, Barry and Whitney and a few others, who contributed then, were missed from the screens; however, the exhibition was quite attractive and many of the sea views were fine and well executed.

The following is the list of contributors:

Miss Mary Allen.
John P. Benson.
Mrs. C. A. Benjamin.
Miss Martha O. Barrett.
Miss M. C. Bolles.
Mrs. M. A. Bovie.
Miss M. M. Brooks.
Miss Anna N. Benjamin.
Bates & Brigham.
Miss M. J. Butler.
Miss Harriet E. Carlton, Cambridge.
Miss Lizzie Chever.
Miss C. M. Colcord, Swampscott.
Miss Ida Caller.
Miss A. L. Chadwick.
Miss E. W. Chadwick.
Joseph A. Davis.
Miss Ellen M. Dole.
" Grace G. Dalton.
" Edith Dalton.
" M. E. Dockham.
Arthur W. Dow, Ipswich.
Kilby W. Elwell, Gloucester.
W. B. Eaton.
Miss Lizzie J. Emery.
" A. Endicott.
" E. W. Fiske.
" C. S. Fiske.
" Elizabeth B. Gardner.
" Bessie W. Gardner.
" May Gardner.
" Carrie Goldthwaite.
" Grace D. Glidden, Wenham.
Sidney P. Guild, Lynn.
Mrs. George Harrington.
H. B. Harrington.
Miss Anna Hyde.
" Jennie Hyde.
Miss A. L. Hobbs, Haverhill.
" M. L. Hill.
" Lucy B. Hood.
" L. D. Harris.
G. W. Harvey.
Mrs. S. K. Hart.
Miss Edith Harlow.
Arthur Harlow.
E. D. Harlow.
Miss Mabel W. Haskell.
" Anna B. Holden, Providence, R. I.
Mrs. H. F. Jacobs.
Miss I. S. Jackson.
Frank R. Kimball.
Miss S. S. Kimball.
" Mary L. King.
" Louisa Lander.
Mrs. John H. Langmaid.
E. C. Larrabee.
Warren Marston, Gloucester.
Mrs. H. N. Mudge, Marblehead.
Ernest Machado.
Miss McMullen.
Miss T. R. Nason.
" Martha W. Nichols.
" Northend.
Mrs. T. M. Osborne.
Miss H. F. Osborne.
" E. T. Oliver.
" Bessie S. Osgood.
" Edith P. Pickering.
" Abbie G. Pingree.
" M. E. Phippen.
" Helen Philbrick.
" Anna B. Perkins.
" L. Perkins.
James Powers.
Miss Lottie Perkins.
" Minnie Pond.
" A. L. Pierson.

Miss Elizabeth A. Pinnock.
" A. P. Pitman.
" A. M. Quimby.
C. C. Redmond.
Beverly Rantoul.
Miss Rantoul.
" Carrie L. Read.
" Lizzie L. Read.
Mrs. J. H. Roberts.
Miss M. E. Roberts.
" B. P. Smith.
" M. T. Smith.
" M. Simonds.
Mrs. N. G. Simonds.
Arthur L. Sanders.
Miss S. E. Smith.
Mrs. Joseph Symonds.
Miss A. C. Symonds.
" S. Sweetser.
" M. K. Stevens.
Mrs. G. L. Streeter.
Miss Delia Sheldon.
Mrs. S. E. Thayer.
Miss A. S. Tukey.
Miss I. F. Upton.
Miss L. L. A. Very.
" Gertrude M. Very.
Mrs. S. E. Varney.
Miss F. White.
Charles H. Woodbury, Lynn.
Mrs. K. T. Woods.
Henry Whipple.

Excursion.—On Wednesday, May 21, 1884, a party of fifty members and friends left Salem on an excursion to Mauch Chunk, Luray Cave, the Natural Bridge in Virginia and Washington. Vice President F. W. Putnam was with the party, and while at the Natural Bridge gave a lecture on the geology of that vicinity, stating his theory of the formation of the bridge. There are two ways by which ravines are cut. First, like that of Niagara and the cañons of Colorado and its tributaries. Secondly, like that of caves. The limestone of this region is probably lower silurian and the strata are tilted at many angles. Beginning at the Lace Water Falls, a mile above the bridge, the strata are vertical. They here begin to incline more and more towards the horizontal, which position is reached at the bridge. The limestone water, percolating through the fissures between the strata, acts both chemically and mechanically upon them, working out a deeper channel, and at the same time depositing incrusting matter as it seeks the level of drainage. This ravine was once a vast cave, the bridge being the only remaining relic of the

roof. This has stood because its limestone is more crystalline than that above and below it. It is flinty and is probably corniferous.

Stalactites and stalagmites are formed in the old chambers of the caves by the percolation of water through the fissures in the rocks, while the degradation and channeling are going on in the new chambers. In the case of the Natural Bridge, this action went on faster than the building process, hence the roof became too thin to sustain its weight and fell in, leaving the fragment forming the bridge to tell the story. The professor then told the company of the formation of caves in general, many of which he has explored, making particular mention of the Mammoth cave and of peculiar formations found in it.

Rev. B. F. McDaniel explained the formation of tufa and the varieties of incrusting minerals in caves. Col. H. C. Parsons, the proprietor, told of the caves in the neighborhood. Several of them have been opened, but not thoroughly explored. Until they can be properly opened up, he deems them unsafe for amateur explorers.

This estate of Mr. Parsons, of some 2,000 acres, comprises a horse-shoe range of lofty, wooded hills, enclosing the basin on whose slopes lie the hotels and the owner's residence. The Horse Shoe opens towards the east and commands a grand and beautiful view of the Blue Ridge, forest-covered and mist-crowned, rising 4,300 feet above the sea. A little to the left the glint of broken granite alone shows where the river burst through, and at the right the crest lowers so that the Peaks of Otter may overlook.

The Groveland Flower Mission, thirty-eight in number, ladies and gentlemen, came to Salem June 24 by joint invitation of the Peabody Academy of Science and the Essex Institute.

They were entertained by the two societies and visited the various points of interest in and about Salem.

FINANCIAL.—The following is the Treasurer's Report of the receipts and expenditures of the past year (condensed for printing):

RECEIPTS.

Balance of last year's account		$0 94
Income of General account,		
Assessments of members, ...	$811 00	
Publications, ...	196 33	
Use of Hall, Excursions, etc., ...	218 35	
Bank Dividend, ...	20 00	
Return State tax, ...	8 91	
Salem Athenæum, portion of expense, ...	206 40	
		1,460 99
Income of Historical Fund, ...	12 00	
" " Nat. Hist. Soc. Fund, ...	36 00	
" " Davis Fund, ...	392 68	
" " Ditmore Fund, ...	180 40	
" " Manuscript Fund, ...	26 96	
" " Ladies' Fair Fund, ...	60 00	
" " Derby Fund, ...	17 30	
" " Howes Fund, ...	1,430 00	
" " Story Fund, ...	563 00	
		2,718 34
Bequest of Robert Peele and sister	2,000 00	
Income from the same, ...	135 00	
		2,135 00
Balance due the Treasurer, ...		117 52
		$6,432 79

EXPENDITURES.

Paid on General Account.		
Salaries, ...	1,882 00	
Publications, ...	807 07	
Fuel and Gas, ...	233 53	
Binding, Printing, Stationery, etc., ...	119 37	
Repairs, expressage, etc., ...	171 38	
Fire Insurance prem., ...	122 50	
Salem Athenæum, as per agreement, ...	350 00	3,685 85
Paid on Historical account, ...	53 25	
" " Nat. Hist. account, ...	53 25	106 50
" " Ditmore annuity, ...	110 00	
Paid Legatee—Augustus Story's Estate, ...	563 00	673
Interest Davis fund, funded in Savings Bank, ...	12 68	
Interest Manuscript fund, funded in Savings Bank, . .	26 96	
Interest Derby fund, funded in Savings Bank, ...	17 30	
Deposit Salem Savings Bank, part of Robert Peele and sister's legacy, ...	1,500 00	1,556 94
Paid note at Salem National Bank and Interest, . . .	410 50	410 50
		$6,432 79
The invested funds are now, ...		$47,389 54

Examined and approved by the Auditor, May 18, 1885.

The secretary in concluding his report says, "In addition to the accumulations of former years which it has been impossible to arrange on the shelves for want of room, there have been added since the last annual meeting, many books and a great collection of pamphlets, to say nothing of the large amount of printed matter, such as circulars, notices, etc. The subject of increased accommodations is, it is true, an old story, but as donations continue to flow into the building the necessity of more shelf-room forces itself on the attention of the officers of the Institute and those who frequent the library. The subject is again brought to the attention of the directors in the hope that before another year shall have passed, some decided action in this direction will be taken."


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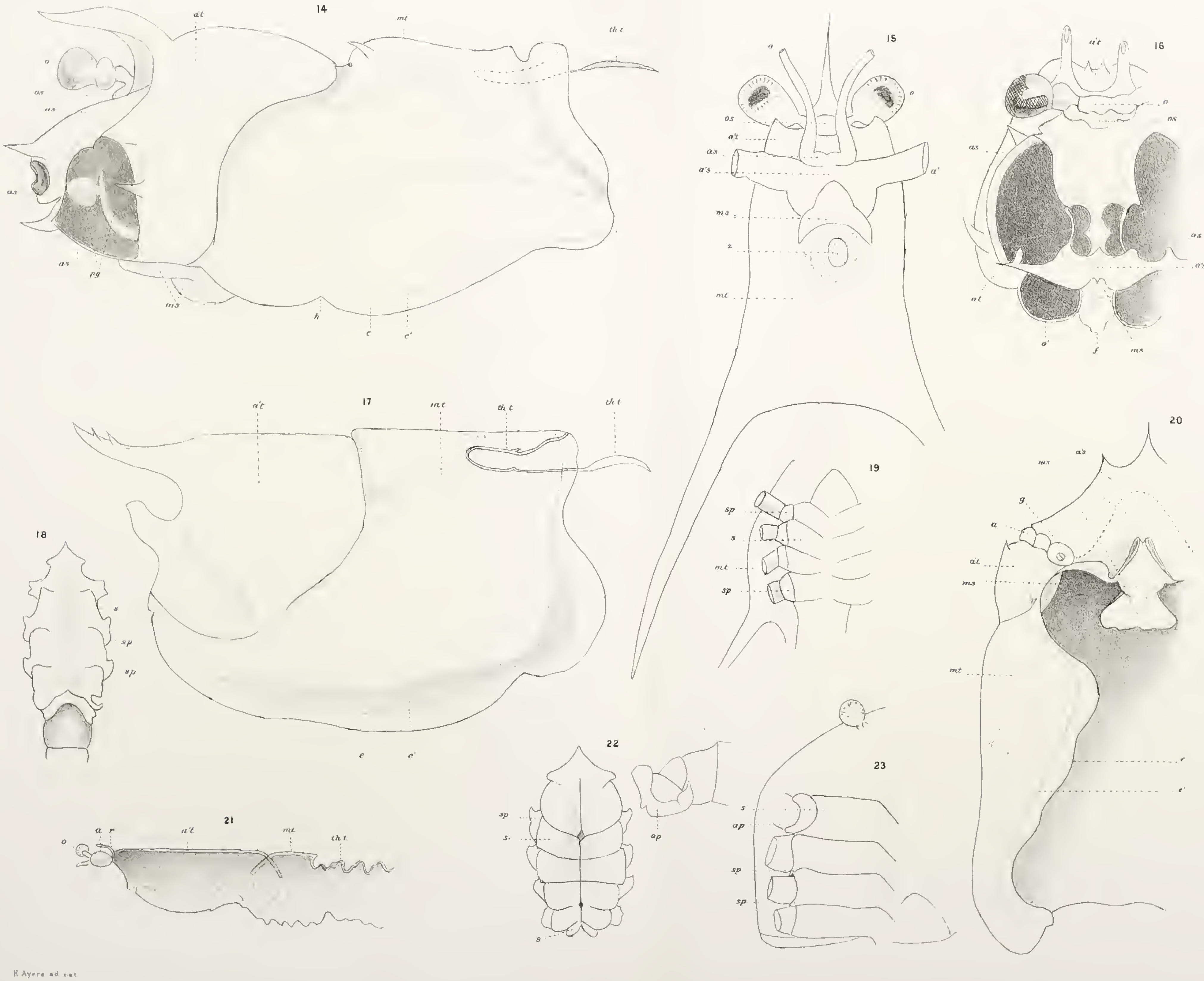

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Printed by B Meisel

BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 17. SALEM: JULY, AUG., SEPT., 1885. NOS. 7-9.

INDIAN GAMES.

BY ANDREW McFARLAND DAVIS.

"THERE are," says Father Brebeuf in his account of what was worthy of note among the Hurons in 1636,[1] "three kinds of games particularly in vogue with this people; cross, platter, and straw. The first two are, they say, supreme for the health. Does not that excite our pity? Lo, a poor sick person, whose body is hot with fever, whose soul foresees the end of his days, and a miserable sorcerer orders for him as the only cooling remedy, a game of cross. Sometimes it is the invalid himself who may perhaps have dreamed that he will die unless the country engages in a game of cross for his health. Then, if he has ever so little credit, you will see those who can best play at cross arrayed, village against village, in a beautiful field, and to increase the excitement, they will wager with each other their beaver skins and their necklaces of porcelain beads."

"Sometimes also one of their medicine men will say that the whole country is ill and that a game of cross is

[1] Relations des Jésuites, Québec, 1858, p. 113.

needed for its cure. It is not necessary to say more. The news incontinently spreads everywhere. The chiefs in each village give orders that all the youths shall do their duty in this respect, otherwise some great calamity will overtake the country."

LACROSSE.

In 1667, Nicolas Perrot, then acting as agent of the French government, was received near Saut Sainte Marie with stately courtesy and formal ceremony by the Miamis, to whom he was deputed. A few days after his arrival, the chief of that nation gave him, as an entertainment, a game of lacrosse.[2] "More than two thousand persons assembled in a great plain each with his cross. A wooden ball about the size of a tennis ball was tossed in the air. From that moment there was a constant movement of all these crosses which made a noise like that of arms which one hears during a battle. Half the savages tried to send the ball to the northwest the length of the field, the others wished to make it go to the southeast. The contest which lasted for a half hour was doubtful."

In 1763, an army of confederate nations, inspired by the subtle influence of Pontiac's master mind, formed the purpose of seizing the scattered forts held by the English along the northwestern frontier. On the fourth day of June of that year, the garrison at Fort Michilimackinac, unconscious of their impending fate, thoughtlessly lolled at the foot of the palisade and whiled away the day in watching the swaying fortunes of a game of ball which was being played by some Indians in front of the stockade. Alexander Henry, who was on the spot at the time,

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[2] Histoire de l'Amérique Septentrionale par M. de Bacqueville de la Potherie, Paris, 1722, Vol. II, 124 *et seq.*

says that the game played by these Indians was "Baggatiway, called by the Canadians *le jeu de la Crosse*."[3]

Parkman[4] concludes a vivid description of the surprise and massacre of the garrison at Michilimackinac, based upon authentic facts, as follows: "Rushing and striking, tripping their adversaries, or hurling them to the ground, they pursued the animating contest amid the laughter and applause of the spectators. Suddenly, from the midst of the multitude, the ball soared into the air and, descending in a wide curve, fell near the pickets of the fort. This was no chance stroke. It was part of a preconcerted scheme to insure the surprise and destruction of the garrison. As if in pursuit of the ball, the players turned and came rushing, a maddened and tumultuous throng, towards the gate. In a moment they had reached it. The amazed English had no time to think or act. The shrill cries of the ball-players were changed to the ferocious war-whoop. The warriors snatched from the squaws the hatchets which the latter, with this design, had concealed beneath their blankets. Some of the Indians assailed the spectators without, while others rushed into the fort, and all was carnage and confusion."

Thus we see that the favorite game of ball of the North American Indians, known to-day, as it was in 1636, by the name of "lacrosse," was potent among them as a remedial exercise or superstitious rite to cure diseases and avert disaster; that it formed part of stately ceremonials which were intended to entertain and amuse distinguished guests; and that it was made use of as a stratagem of war,

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[3] Travels and Adventures in Canada, etc., by Alexander Henry, New York, 1809, p. 78; Travels through the Interior parts of North America, by Jonathan Carver London, 1778, p. 19. The Book of the Indians, by Samuel G. Drake, Boston, 1841, Book V, Ch. III, p. 52.

[4] The Conspiracy of Pontiac, by Francis Parkman, Boston, 1870. Vol. I, p. 339.

by means of which to lull the suspicions of the enemy and to gain access to their forts.

The descriptions of lacrosse which have been transmitted to us, would often prove unintelligible to one who had never seen the game played. The writers of the accounts which have come down to us from the early part of the seventeenth century were men whose lives were spent among the scenes which they described and they had but little time, and few opportunities for careful writing. The individual records though somewhat confused enable us easily to identify the game, and a comparison of the different accounts shows how thoroughly the main features of the game have been preserved.

Lacrosse is played to-day as follows: The number of players on the opposing sides should be equal. Regular stations are assigned in the rules for playing the game, for twelve on each side. Goals, each consisting of two upright posts or staffs, generally about six feet apart and of equal height, are planted at each end of the field. The length of the field and its bounds are determined by the character of the ground and the skill of the players. The effort of each side is to prevent the ball from passing through the goal assigned to its protection, and equally to try to drive it through the opposite goal. Under no circumstances can the ball be touched during the game, while within the bounds, by the hands of the players. Each player has a racket, the length of which, though optional, is ordinarily from four to five feet. One end of this racket or bat is curved like a shepherd's crook, and from the curved end a thong is carried across to a point on the handle about midway its length. In the space thus enclosed between the thong and the handle, which at its broadest part should not exceed a foot in width, a flat network is interposed. This forms the bat. It is with

this that the player picks up and throws the ball used in the game, which should be about eight or nine inches in circumference. The ball is placed in the centre of the field by the umpire, and when the game is called, the opposing players strive to get possession of it with their rackets. The play consists in running with it and throwing it, with the design of driving it between the adversary's goal posts ; and in defensive action, the purpose of which is to prevent the opponents from accomplishing similar designs on their part. As the wind or the sunlight may favor one side or the other on any field, provision is generally made for a change of goals during the match. The stations of the players and the minor rules of the game are unimportant in this connection.

The oldest attempt at a detailed description of the game is given by Nicolas Perrot who from 1662 to 1699 spent the greater part of his time as *coureur de bois*, trader, or government agent, among the Indians of the far West. It is of him that Abbé Ferland says, "Courageous man, honest writer and good observer, Perrot lived for a long time among the Indians of the West who were very much attached to him." His accounts of the manners and customs of the North American Indians have been liberally used by subsequent writers and as the part treating of games is not only very full but also covers a very early period of history, it is doubly interesting for purposes of comparison with games of a later day. He[5] says, "The savages have many kinds of games in which they delight. Their natural fondness for them is so great that they will neglect food and drink, not only to join in a game but even to look at one. There is among them a certain game

[5] Mémoire sur les Moeurs, Coustumes et Relligion des Sauvages de l'Amérique Septentrionale, par Nicolas Perrot, Leipzig et Paris, 1864, p. 43, *et seq.*

of cross which is very similar to our tennis. Their custom in playing it is to match tribe against tribe, and if the numbers are not equal they render them so by withdrawing some of the men from the stronger side. You see them all armed with a cross, that is to say a stick which has a large portion at the bottom, laced like a racket. The ball with which they play is of wood and of nearly the shape of a turkey's egg. The goals of the game are fixed in an open field. These goals face to the east and to the west, to the north and to the south." Then follows a somewhat confused description of the method and the rules of the contest from which we can infer that after a side had won two goals they changed sides of the field with their opponents, and that two out of three, or three out of five goals decided the game.

Reading Perrot's description in connection with that given by de la Potherie of the game played before Perrot by the Miamis, helps us to remove the confusion of the account. Abbé Ferland[6] describes the game. He was a diligent student of all sources of authority upon these subjects and was probably familiar with the modern game. His account of the Indian game follows that of Perrot so closely as to show that it was his model. It is, however, clear and distinct in its details, free from the confusion which attends Perrot's account and might almost serve for a description of the game as played by the Indians to-day. Perrot was a frontier-man and failed when he undertook to describe anything that required careful and exact use of language. We can only interpret him intelligently by combining his descriptions with those of other writers and applying our own knowledge of the game as we see it to-day. He is, however, more intelligible

[6] Cours d'Histoire du Canada, par J. B. A. Ferland, Québec, 1861, Vol. I, p. 134.

when he gets on more general ground, and after having disposed of the technicalities of the game, he proceeds: "Men, women, boys and girls are received on the sides which they make up, and they wager between themselves more or less according to their means."

"These games ordinarily begin after the melting of the ice and they last even to seed time. In the afternoon one sees all the players bedecked[7] and painted. Each party has its leader who addresses them, announcing to his players the hour fixed for opening the game. The players assemble in a crowd in the middle of the field and one of the leaders of the two sides, having the ball in his hands casts it into the air. Each one then tries to throw it towards the side where he ought to send it. If it falls to the earth, the player tries to draw it to him with his cross. If it is sent outside the crowd, then the most active players, by closely pursuing it, distinguish themselves. You hear the noise which they make striking against each other and warding off blows, in their strife to send the ball in the desired direction. When one of them holds the ball between his feet, it is for him, in his unwillingness to let it go, to avoid the blows which his adversaries incessantly shower down upon his feet. Should he happen to be wounded at this juncture, he alone is responsible for it. It has happened that some have had their legs broken, others their arms and some have been killed. It is not uncommon to see among them those who are crippled for life and who could only be at such a game by an

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[7] I translate *apiffez*, "bedecked," assuming from the context that the author meant to write "*attifez*." We have, elsewhere, accounts which show that ball-players, even though compelled to play with scant clothing, still covered themselves with their ornaments. J. M. Stanley in his Portraits of North American Indians, Smithsonian Miscellaneous Collections, Washington, 1862, Vol. II, p. 13, says that the "Creek" ball-players first appear on the ground in costume. "During the play they divest themselves of all their ornaments which are usually displayed on these occasions for the purpose of betting on the result of the play."

act of sheer obstinacy. When accidents of this kind happen, the unfortunate withdraws quietly from the game if he can do so. If his injury will not permit him, his relations carry him to the cabin and the game continues until it is finished as if nothing had happened."

"When the sides are equal the players will occupy an entire afternoon without either side gaining any advantage; at other times one of the two will gain the two games that they need to win. In this game you would say to see them run that they looked like two parties who wanted to fight. This exercise contributes much to render the savages alert and prepared to avoid blows from the tomahawk of an enemy, when they find themselves in a combat. Without being told in advance that it was a game, one might truly believe that they fought in open country. Whatever accident the game may cause, they attribute it to the chance of the game and have no ill will towards each other. The suffering is for the wounded, who bear it contentedly as if nothing had happened, thus making it appear that they have a great deal of courage and are men."

"The side that wins takes whatever has been put up on the game and whatever there is of profit, and that without any dispute on the part of the others when it is a question of paying, no matter what the kind of game. Nevertheless, if some person who is not in the game, or who has not bet anything, should throw the ball to the advantage of one side or the other, one of those whom the throw would not help would attack him, demanding if this is his affair and why he has mixed himself with it. They often come to quarrels about this and if some of the chiefs did not reconcile them, there would be blood shed and perhaps some killed."

Originally, the game was open to any number of com-

petitors. According to the Relation of 1636, "Village was pitted against village." "Tribe was matched against tribe," says Perrot. The number engaged in the game described by La Potherie[8] was estimated by him at two thousand. LaHontan[9] says that "the savages commonly played it in large companies of three or four hundred at a time," while Charlevoix[10] says the number of players was variable and adds "for instance if they are eighty," thus showing about the number he would expect to find in a game. When Morgan[11] speaks of six or eight on a side, he must allude to a later period, probably after the game was modified by the whites who had adopted it among their amusements.[12]

Our earliest accounts of the game as played by the Indians in the south are about one hundred years later than the corresponding records in the north. Adair[13] says the

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[8] Vol. II, p. 126.

[9] Mémoires de L'Amérique Septentrionale, ou la Suite des Voyages de Mr. Le Baron de LaHontan, Amsterdam, 1705, Vol. II, p. 113.

[10] Histoire de la Nouvelle France. Journal d'un Voyage, etc., par le P. de Charlevoix, Paris, 1744, Vol. III, p. 319.

[11] League of the Iroquois, by Lewis H. Morgan, Rochester, 1851, p. 294.

[12] The game is also mentioned in An Account of the Remarkable Occurrences in the Life and Travels of Col. James Smith during his Captivity with the Indians in the years 1755–1759. Cincinnati, 1870, p. 78. It is described by Col. William L. Stone in his Life of Brant, Albany, 1865, Vol. II, p. 448. In one game of which he speaks, the ball was started by a young and beautiful squaw who was elaborately dressed for the occasion. Notwithstanding the extent and value of Col. Stone's contributions to the literature on the subject of the North American Indians, he makes the erroneous statement that "The Six Nations had adopted from the Whites the popular game of ball or cricket." See p. 445, same volume, *c.f.* The Memoir upon the late War in North America, 1755–1760, by M. Pouchot, translated and edited by Franklin B. Hough, Vol. II, p. 195. A game of ball is also described in Historical Collections of Georgia, by the Rev. George White, 3d edition, New York, 1855, p. 670, which took place in Walker County, Georgia, between Chatooga and Chicamauga. The ball was thrown up at the centre. The bats were described as curiously carved spoons. If the ball touched the ground the play stopped and it was thrown up again. Rev. J. Owen Dorsey in a paper entitled "Omaha Sociology," printed in the Third Annual Report of the Bureau of Ethnology, etc., 1881–1882, Washington, 1884, §230, p. 336, describes the game amongst the Omahas.

[13] The History of the American Indians, particularly those Nations adjoining to the Mississippi, etc., by James Adair, London, 1775, p. 399.

gamesters are equal in number and speaks of "the crowd of players" preventing the one who "catches the ball from throwing it off with a long direction." Bossu[14] says, "they are forty on each side," while Bartram[15] says, "the inhabitants of one town play against another in consequence of a challenge." From this it would seem that among those Indians, as at the North, the number of players was governed only by the circumstances under which the game was played.

The ball, originally of wood,[16] was replaced by one made of deer skin. Adair gives the following description of its manufacture: "The ball is made of a piece of scraped deer-skin, moistened, and stuffed hard with deer's hair, and strongly sewed with deer's sinews."[17]

According to Morgan the racket has undergone a similar change, from a curved wooden head to the curved stick with open network, but we have seen in the earliest description at our command, that in the days of Perrot the cross was "laced like a racket."[18]

The game was played not only by the Indians of our Coast, but Powers[19] found it also among the Californian Indians. He describes a game of tennis played by the Pomo Indians in Russian River Valley, of which he had heard nothing among the northern tribes. "A ball is rounded out of an oak knot as large as those used by school boys, and it is propelled by a racket which is constructed of a

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[14] Travels through that Part of North America formerly called Louisiana, by Mr. Bossu, Captain in the French Marines. Translated from the French by John Reinhold Forster, London, 1771, Vol. I, p. 304.

[15] Travels through North and South Carolina, etc., by William Bartram, Philadelphia, 1791, p. 508.

[16] La Potherie, Vol. II, p. 126; Perrot, p. 44.

[17] p. 400.

[18] League of the Iroquois, p. 298; Perrot p. 44.

[19] Contributions to North American Ethnology, Vol. III, p. 151. Tribes of California by Stephen Powers; The same game is described among the Meewocs in The Native Races of the Pacific States by H. H. Bancroft, Vol. I, p. 393.

long slender stick, bent double and bound together, leaving a circular hoop at the extremity, across which is woven a coarse meshwork of strings. Such an implement is not strong enough for batting the ball, neither do they bat it, but simply shove or thrust it along the ground."

Paul Kane[20] describes a game played among the Chinooks. He says "They also take great delight in a game with a ball which is played by them in the same manner as the Cree, Chippewa and Sioux Indians. Two poles are erected about a mile apart, and the company is divided into two bands armed with sticks, having a small ring or hoop at the end with which the ball is picked up and thrown to a great distance, each party striving to get the ball past their own goal. They are sometimes a hundred on a side, and their play is kept up with great noise and excitement. At this play they bet heavily as it is generally played between tribes or villages."

Domenech[21] writing about the Indians of the interior, calls the game "cricket," and says the players were costumed as follows: "Short drawers, or rather a belt, the body being first daubed over with a layer of bright colors; from the belt (which is short enough to leave the thighs free) hangs a long tail, tied up at the extremity with long horse hair; round their necks is a necklace, to which is attached a floating mane, dyed red, as is the tail, and falling in the way of a dress fringe over the chest and shoulders. * * In the northwest, in the costume indispensable to the players, feathers are sometimes substituted for horse hair." He adds "that some tribes play with two sticks" and that it is played in "winter on the ice." "The ball is made of wood or brick covered with kid-skin leather, sometimes of

[20] Wanderings of an Artist among the Indians of North America by Paul Kane, p. 190; H. H. Bancroft's Native Races, Vol. I, p. 244.

[21] Seven Years' Residence in the Great Deserts of North America by the Abbé Em. Domenech, Vol. II, pp. 192, 193.

leather curiously interwoven." Schoolcraft describes the game as played in the winter on the ice.[22]

It will be observed that the widest difference prevails in the estimate of the distance apart at which the goals are set. Henry, in his account of the game at Michilimackinac says "they are at a considerable distance from each other, as a mile or more." Charlevoix places the goals in a game with eighty players at "half a league apart" meaning probably half a mile. LaHontan estimates the distance between the goals at "five or six hundred paces." Adair,[23] who is an intelligent writer, and who was thoroughly conversant with the habits and customs of the Cherokees, Choctaws, and Chicasaws estimates the length of the field at "five hundred yards," while Romans[24] in describing the goals uses this phrase "they fix two poles across each other at about a hundred and fifty feet apart." Bossu[25] speaks as if in the game which he saw played there was but a single goal. He says "They agree upon a mark or aim about sixty yards off, and distinguished by two great poles, between which the ball is to pass."

The goals among the northern Indians were single posts at the ends of the field. It is among the southern Indians that we first hear of two posts being raised to form a sort of gate through or over which the ball must pass. Adair says, "they fix two bending poles into the ground, three yards apart below, but slanting a considerable way out-

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[22] Schoolcraft's North American Indians, Vol II, p. 78; See also Ball-play among the Dacotas, in Philander Prescott's paper, Ibid, Vol. IV, p. 64.

[23] Henry, p. 78; Charlevoix Vol. III, p. 319; Kane's Wanderings, p. 189; LaHontan, Vol. II, p. 113; Adair, p. 400.

[24] A concise Natural History of East and West Florida, by Capt. Bernard Romans, New York, 1776, p. 79.

[25] Vol. I, p. 304; Similarly, Pickett (History of Alabama, Vol. I, p. 92) describes a game among the Creeks in which there was but one goal, consisting of two poles erected in the centre of the field between which the ball must pass to count one. He cites "Bartram," and the "Narrative of a Mission to the Creek Nation by Col. Marinus Willett," as his authorities. Neither of them sustains him on this point.

wards. The party that happens to throw the ball over these counts one; but if it be thrown underneath, it is cast back and played for as usual." The ball is to be thrown "through the lower part" of the two poles which are fixed across each other at about one hundred and fifty feet apart, according to Romans. In Bossu's account it is "between" the two great poles which distinguish the mark or aim, that "the ball is to pass." On the other hand, Bartram, describing what he saw in North Carolina, speaks of the ball "being hurled into the air, midway between the two high pillars which are the goals, and the party who bears off the ball to their pillar wins the game."

In some parts of the south each player had two rackets between which the ball was caught. For this purpose they were necessarily shorter than the cross of the northern Indians. Adair says, "The ball sticks are about two feet long, the lower end somewhat resembling the palm of a hand, and which are worked with deer-skin thongs. Between these they catch the ball, and throw it a great distance."[26]

That this was not universal throughout the south would appear from Bossu's account who says, "Every one has a battledoor in his hand about two feet and a half long, made very nearly in the form of ours, of walnut, or chestnut wood, and covered with roe-skins." Bartram also says that each person has "a racquet or hurl, which is an implement of a very curious construction somewhat resembling a ladle or little hoop net, with a handle near three feet in length, the hoop and handle of wood and the netting of thongs of raw-hide or tendons of an animal."

Catlin[27] saw the game played by the Choctaws on their

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[26] Adair, p. 400; A Narrative of the Military Adventures of Colonel Marinus Willett, p. 109.

[27] Letters and Notes on the Manners, Customs and Condition of the North American Indians, by George Catlin, Vol. II, p. 123 *et seq.*

Western Reservation. They used two rackets. In this game the old men acted as judges.

The game was ordinarily started by tossing the ball into the air in the centre of the field. This act is represented by Perrot as having been performed by one of the leaders in the game, but it is more in accord with the spirit in which the game was played, that it should have been done by some outsider. Bossu says, "An old man stands in the middle of the place appropriated to the play, and throws up into the air a ball of roe-skins rolled about each other," while Powers[28] says that among the Californian Indians this act was performed by a squaw. The judges started the ball among the Choctaws.[29] Notwithstanding the differences in the forms of the goals, their distance apart and the methods of play disclosed in all these descriptions, the game can only be regarded as the same. The historians who have preserved for us the accounts of the ancient southern games from which quotations have been made, are all Englishmen except Bossu, and he entered the country not by the way of Quebec but by way of New Orleans. It is not strange, therefore, that we do not find in use amongst them the name which the early French fathers and traders invariably applied to the game. The description, however, given by these writers, of the racket used in the south, corresponds so closely with the crook from which the game took the name by which it is known, that we must accept the game as a modified form of lacrosse. From Maine to Florida, from the Atlantic to the Pacific, we trace a knowledge of it. We have found it in use among the confederate nations of the north and of the south and among scattered tribes throughout the country.

In the majority of instances the natural instincts of those

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[28] Contributions to North American Ethnology, Vol. III, p. 151.

[29] Catlin, Vol. II, p. 125.

who participated in the strife were stimulated by local pride. The reputation of their tribe or their village rested upon the result. Ardent as the spirit of the contest must necessarily have been under such circumstances, among a people where courage and physique counted for so much, their intense passion for gambling intervened to fan into fiercer flames the spirits of the contesting players and to inspire them to more earnest efforts. Stakes, often of the utmost consequence to the players and their backers, were wagered upon the games. A reputation for courage, for skill and for endurance, was the most valuable possession of the Indian. The maintenance of this was to a certain extent involved in each game that he played. Oftentimes in addition to this, all of his own possessions and the property of his friends and neighbors in the form of skins and beads were staked upon the result of the contest. In games where so much was involved, we need not be surprised to learn from Perrot that limbs were occasionally broken and that sometimes players were even killed. In the notes to Perrot's Memoir it is stated that some anonymous annotator has written across the margin of Perrot's manuscript at this point:[30] "False, neither arms nor legs are broken, nor are players ever killed." We scarcely need the corroboratory statements of La Potherie[31] that "these games are ordinarily followed by broken heads, arms and legs, and often people are killed at them;" and also of LaHontan,[32] that "they tear their skins and break their legs" at them, to satisfy us that Perrot rather than his critic is to be believed. If no such statements had been made, we should infer that so violent a game, on which stakes of such vital importance were placed, could not be played by a people like the Indians, except with such results.

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[30] Perrot, Note I, Ch. x, p. 187. [31] Vol. II, pp. 126-127. [32] Vol. II, p. 113.

Notwithstanding the violence of the game and the deep interest which the players and spectators took in it, the testimony of historians is uniform to the effect that accidental injuries received during its progress produced no ill will. We have seen that Perrot states that if anyone attempted to hold the ball with his feet, he took his chance of injury, and that those who were injured retired quietly from the field. Adair says, "It is a very unusual thing to see them act spitefully, not even in this severe and tempting exercise." Bossu bears testimony to the same effect, in the following words: "The players are never displeased; some old men, who assist at the play, become mediators, and determine that the play is only intended as a recreation, and not as an opportunity of quarrelling."

Where the game was played by appointment in response to a challenge, the men and women assembled in their best ornaments, and danced and sang during the day and night previous to that of the appointed day. The players supplicated the Great Spirit for success. Female relations chanted to him all the previous night and the men fasted from the previous night till the game was over.[33] The players wore but little in the way of covering. Romans speaks of them as being "almost naked, painted and ornamented with feathers;" and Bossu says they were "naked, painted with various colours, having a tyger tail fastened behind, and feathers on their heads and arms."

It is not astonishing that a game which called for such vigorous exercise[34] and which taxed the strength, agility and endurance of the players to such a degree, should be described by writers in terms which showed that they

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[33] Adair, p. 401; Bossu, Vol. I, p. 304; and Willett's Narrative p. 109.

[34] Ferland, Vol. I, p. 134, and Major C. Swan in a Report concerning the Creeks in 1791, Schoolcraft, Vol. V, p. 277, assert that the Whites excel the Indians at this game.

looked upon it rather in the light of a manly contest than as an amusement. Nevertheless the young people and the women often took part in it. Perrot tells us so, and both Romans and Bossu say that after the men were through, the women usually played a game, the bets on which were generally high. Powers[35] represents the squaws among the Californian Indians as joining the game.

Dexterity in the game lay in the skilful use of the racket; in rapid running; in waylaying an adversary when he was in possession of the ball; in avoiding members of the opposing side when the player himself was running with the ball for the goal, and in adroitly passing the ball to one of the same side when surrounded by opponents. To give full scope to skill in the use of the racket, great stress was laid upon the rule that the ball was not to be touched by the hand. Perrot says, " if it falls to the earth he tries to draw it to him with his cross." Charlevoix says, "Their business is to strike the ball to the post of the adverse party without letting it fall to the ground and without touching it with the hand." Adair says, " They are not allowed to catch it with their hands."

The early writers were struck with the fact that the character of the exercise in this game was fitted to develop the young warriors for the war path, and they commented on the practice that they thus acquired in rapid running and in avoiding blows from an instrument in the hands of an adversary.

When we review the various features of the game which its chroniclers have thought worthy of record, we can but conclude that it was rather a contest of grave importance to the players than a mere pastime, nor can we fail to accept the concurrent testimony as to the widespread terri-

[35] Contributions to North American Ethnology, Vol. III, p. 151.

tory in which it was domesticated, as additional evidence of the extent of the intercourse which prevailed among the native tribes of this country.

PLATTER OR DICE.

The second in the list of games given by Father Brebeuf is that which he calls "platter." Writers who describe the habits of the Indians at the north have much to say concerning this game. According to Lescarbot, Jacques Cartier saw it played, and recorded his observations.[36]

Sagard Theodat [37] devotes considerable space to it. Both Father Brebeuf, in his Relation in 1636, and Father Lalemant, in his Relation in 1639, give long accounts of the game, the causes for its being played, the excesses in gambling to which it leads, and the methods which prevail in its practice. In Perrot's[38] work there is a good description of the game, although not so full as his account of lacrosse, from which we have already quoted. La Potherie and LaHontan barely mention it. Lafitau[39] in his searching analysis of the manuscripts deposited at Quebec, while seeking for traces of his theory that a resemblance existed between the habits of the Indians and those of the ancient dwellers in eastern Europe, found an unusual quantity of material bearing on this particular topic, which he has reproduced in his book. Charlevoix[40], in a letter dated June 8, 1721, says, "As I was returning through a quarter of the Huron village, I perceived a number of these Indians, who seemed much heated at play. I

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[36] Histoire de la Nouvelle France par Marc Lescarbot, Nouvelle Edition, Paris 1866, Vol. III, p. 754.

[37] Histoire du Canada, etc., par Gabriel Sagard Theodat; Nouvelle Edition, Paris, 1866, Vol. I, pp. 243-244.

[38] p. 50.

[39] Mœurs des Sauvages Ameriquains, etc., par le P. Lafitau, Paris, 1724, Vol. II, p. 339.

[40] Vol. III, pp. 260-1.

approached them and found that the game they were playing at was what they called the game of platter. This is the game to which the Indians are addicted above all others. They sometimes lose their rest and in some degree their very senses at it. They stake all they are worth, and several of them have been known to continue at it till they have stript themselves stark naked and lost all their movables in their cabin. Some have been known to stake their liberty for a certain time. This circumstance proves beyond all doubt how passionately fond they are of it, there being no people in the world more jealous of their liberty than our Indians."

In the description which Charlevoix then gives, he has relied partly upon personal observations and also to some extent, upon accounts which were at that time in manuscript in Quebec and which were easily accessible to him. He was himself an intelligent observer and a cultivated man. His history and his letters, although not free from the looseness of expression which pervades contemporaneous accounts show on the whole the discipline of an educated mind. We learn from him and from the authorities heretofore enumerated that two players only from each side could participate in this game at any given time during its progress. The necessary implements were a bowl and a number of dice fashioned somewhat like apricot seeds, and colored differently upon the upper and lower sides. Generally, one side was white and the other black. The number of these dice was generally six. There was no fixed rule as to the materials of which they were made; sometimes they were of bone; sometimes the stones of fruits were used. The important point was that the centre of gravity of each die should be so placed, that when it was thrown into the air, or when the bowl in which it was placed, was vio-

lently twirled, there would be an even chance as to which of its two sides the die would settle upon when it lodged; and in the game as it was played in early times that the whole number of dice used should be uniform in the coloring of the sides, each die having the different sides of different colors. The dice were placed in the bowl which was generally of wood, between the two players who were to cast them in behalf of their respective sides. These casters or throwers were selected by each side and the prevailing motives in their choice were generally based upon some superstitious belief in their luck. Perhaps this one had dreamed that he would win. Perhaps that one was believed to possess some magic power, or some secret ointment which when applied to the dice would cause them to turn up favorably for his side.[41] The spectators were generally arranged in seats along the sides of the cabin[42], placed in tiers so that each person could have a view of the players. They were in more senses than one deeply interested in the game. When the cast was to be made the player would strike the bowl upon the ground so as to make the dice jump into the air[43] and would then twirl the bowl rapidly around. During this process and until it stopped its revolutions and the dice finally settled, the players addressed the dice and beat themselves on their breasts.[44] The spectators during the same period filled the air with shouts and invoked aid from their own protecting powers, while in the same breath they poured forth imprecations on those of their adversaries. The number of points affected the length of the game and was entirely optional. If six dice were used

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[41] Relations des Jésuites, Relation en l'Année, 1636, p. 113.
[42] Ibid, Relation en l'Année, 1639, p. 95.
[43] Sagard Theodat, Vol. I, p. 243.
[44] Shea's Hennepin, p. 300.

and all came up of the same color, the throw counted five.[45] If five of them were of the same color it counted one. Any lower number failed to count. If the caster was unsuccessful he gave place to another, but so long as he continued to win his side would retain him in that position.[46]

The game was often ushered in with singing. Like lacrosse it was prescribed as a remedy for sickness or in consequence of dreams, and the sufferer in whose behalf the game was played was borne to the cabin in which it was to take place. Preliminary fasting and continence were observed, and every effort made that superstition could suggest to discover who would be the lucky thrower and who could aid the caster by his presence at the contest. Old men, unable to walk thither, were brought up on the shoulders of the young men that their presence might be propitious to the chances of the game.[47] The excitement which attended one of these games of chance was intense, especially when the game reached a critical point and some particular throw was likely to terminate it. Charlevoix says the games often lasted for five or six days[48] and oftentimes the spectators concerned in the game, "are in such an agitation as to be transported out of themselves to such a degree that they quarrel and fight, which never happens to the Hurons, except on these occasions or when they are drunk."

Perhaps rum was responsible also for these quarrels; for in the early accounts we are told that losses were philosophically accepted. Father Brebeuf tells of a party

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[45] Among the Delawares it required eight counts of five to win. History of the Mission of the United Brethren among the Indians, etc., G. H. Loskiel. Translated by C. I. Latrobe. Part I, Ch. VIII, p. 106.

[46] Charlevoix, Vol. III, p. 261. [47] Ibid, p. 262.

[48] Loskiel (p. 106) saw a game between two Iroquois towns which lasted eight days. Sacrifices for luck were offered by the sides each night.

who had lost their leggings at one of these games and who returned to their village in three feet of snow as cheerful in appearance as if they had won. There seems to have been no limit to which they would not go in their stakes while under the excitement of the game. Clothing, wife, family and sometimes the personal liberty of the player himself rested in the hazard of the die.[49]

The women often played the game by themselves, though apparently with less formality than characterized the great matches. The latter frequently assumed the same local characteristics that we have seen in the game of lacrosse, and we hear of village being pitted against village as a frequent feature of the game.[50]

Morgan[51] describes a game played by the Iroquois with buttons or dice made of elk-horn, rounded and polished and blackened on one side. The players spread a blanket on the ground; and the dice were tossed with the hand in the air and permitted to fall on the blanket. The counts were determined as in the game of platter by the color of the sides of the dice which were exposed when they settled. The number of the dice was eight.

In Perrot's[52] description of the game of platter he alludes to a game, played with eight dice, on a blanket in precisely this way, but he adds that it was practised by women and girls. La Potherie[53] says that the women sometimes play at platter, but ordinarily they cast the fruit stones with the hand as one throws dice.

Under the name of "hubbub" this game has also been

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[49] Charlevoix, Vol. III, p. 261. Le Grand Voyage du Pays des Hurons, par Gabriel Sagard Theodat, Paris, 1632, Nouvelle Edition, Paris, 1865, p. 85; Relations de Jésuites, Relation de la Nouvelle France, en l'Année 1639, pp. 95-96; Lafitau, Vol. II, p. 341.

[50] Perrot, p. 43; Histoire du Canada, par F. X. Garneau, Vol. I, p. 115.

[51] League of the Iroquois, p. 302. [52] Perrot, p. 50. [53] La Potherie, Vol. III, p. 23.

described by observers among the Abenakis. Ogilby[54] says: "Hubbub is five small Bones in a small Tray; the Bones be like a Die, but something flatter, black on the one side and white on the other, which they place on the Ground, against which violently thumping the Platter, the Bones mount, changing Colour with the windy whisking of their Hands to and fro; which action in that sport they much use, smiting themselves on the Breasts and Thighs, crying out Hub Hub Hub; they may be heard playing at this game a quarter of a mile off. The Bones being all black or white make a double Game; if three of one colour, and two of another, then they afford but a single game; four of a colour and one differing is nothing. So long as the Man wins he keeps the Tray, but if he lose the next Man takes it."

There is but little said about this game in the south by writers. It evidently had no such hold there as among the Hurons and the tribes along the Lakes. Lawson[55] saw it played in North Carolina with persimmon stones as dice. While this fixes the fact that the game had a home among the southern Indians, the way in which it has been slighted by the majority of writers who treat of that section shows that it was not a favorite game there.

To what shall we ascribe this? Its hold upon the northern Indians shows that it was peculiarly adapted to the temperament of the natives, and we should naturally expect to find it as much in use among the tribes of the south as with those of the north. An explanation for this may possibly be found in the difference of the climate. The game was especially adapted for the winter, and while its practice was evidently not exclusively con-

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[54] America, being an Accurate Description of the New World, etc. Collected and Translated by John Ogilby. London, 1670. Book II, Ch. II, p. 155.

[55] History of North Carolina by John Lawson, London, 1718, p. 176.

fined to that season, it is possible that its greater hold upon the affections of the Indians of the north arose from their being obliged to resort to in-door amusements during the protracted winters in that region. From this necessity the southern Indians being in a measure exempt, they continued their out-door games as usual and never became so thoroughly infatuated with this game.

Informal contests were often held between players, in which the use of the bowl or platter was dispensed with. The dice were held in the hand and then tossed in the air. They were allowed to fall upon some prepared surface, generally a deerskin spread for the purpose. The same rules as to the color of the surfaces of the dice when they settled in their places governed the count. This form of the game is sometimes described as a separate game. Boucher[56] calls it *Paquessen.*[57] The women of Oregon played it with marked beaver teeth.[58] Among the Twanas it was played with beaver or muskrat teeth.[59] Powers[60] says that among the Nishinams, a tribe living on the slopes of the Sierra Nevada between the Yuba and Cosumnes rivers, "a game of dice is played by men or women, two, three or four together. The dice, four in number, consist of two acorns split lengthwise into halves, with the outsides scraped and painted red or black. They are shaken in the hand and thrown into a wide flat basket, woven in ornamental patterns. One paint and three whites, or

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[56]True and Genuine Description of New France, etc., by Pierre Boucher, Paris, 1644. Translated under title "Canada in the Seventeenth Century," Montreal, 1883, p. 57.

[57]Played by women and girls. Sagard Theodat, Histoire du Canada, Vol. I, p. 244.

[58]Contributions to North American Ethnology, Vol. I, p. 206, George Gibbs; H. H. Bancroft's Native Races, Vol. I, p. 244; The Northwest Coast by James G. Swan, p. 158.

[59] Bulletin, U. S. Geological Survey, Vol. III, No. 1, April 5, 1877. Rev. M. Eels.

[60] Contributions to North American Ethnology, Vol. III, p. 332.

vice versa, score nothing ; two of each score one ; four alike score four. The thrower keeps on throwing until he makes a blank throw, when another takes the dice. When all the players have stood their turn, the one who has scored the most takes the stakes."

The women of the Yokuts,[61] a Californian tribe which lived in the San Joaquin valley near Tulare Lake, had a similar game. Each die was half a large acorn or walnut shell filled with pitch and powdered charcoal and inlaid with bits of bright colored abaloni shell. Four squaws played and a fifth kept tally with fifteen sticks. There were eight dice and they scooped them up with their hands and dashed them into the basket, counting one when two or five flat surfaces turned up.

Schoolcraft[62] says "one of the principal amusements of a sedentary character is that of various games, success in which depends on luck in numbers. These games, to which both the prairie and forest tribes are addicted, assume the fascination and intensity of gambling ; and the most valued articles are often staked upon the luck of a throw. For this purpose the prairie tribes commonly use the stones of the wild plum or some analogous fruit, upon which various devices indicating their arithmetical value are burned in, or engraved and colored, so as at a glance to reveal the character of the pieces." Among the Dacota tribes this is known by a term which is translated the "game of plum stones." He gives illustrations of the devices on five sets of stones, numbering eight each. "To play this game a little orifice is made in the ground and a skin put in it ; often it is also played on a robe."[63] The women and the young men play this game. The bowl is lifted with one

[61] Contributions to North American Ethnology, Vol. III, p. 377.
[62] Schoolcraft's Indian Tribes, Vol. II, pp. 71, 72.
[63] Domenech, Vol. II, p. 191; First Annual Report of Bureau of Ethnology, Smithsonian, 1881, p. 195.

hand and rudely pushed down to its place. The plum stones fly over several times. The stake is first put up by all who wish to play. A dozen can play at once if desirable.

Schoolcraft[64] describes still another form of the game which he found among the Chippewas, in which thirteen pieces or dice were used. Nine of them were of bone and were fashioned in figures typifying fish, serpents, etc. One side of each was painted red and had dots burned in with a hot iron. The brass pieces were circular having one side convex and the other concave. The convex side was bright, the concave dark or dull. The red pieces were the winning pieces and each had an arithmetical value. Any number of players might play. A wooden bowl, curiously carved and ornamented, was used. This form of the game may have been modified by contact with the whites. It seems to be the most complex[65] form in which the game appears. The fact still remains however, that in some form or other we find the game in use across the entire breadth of the continent.[66]

STRAW OR INDIAN CARDS.

The third game mentioned by Father Brebeuf was that which was called straw. We have seen that the first of these games called for strength, agility and endurance. It was as free from elements of chance as any human contest

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[64] Vol. II, p. 72.

[65] See also a simpler form of the game described by Philander Prescott among the Dacotas.—Schoolcraft, Vol. IV, p. 64. The tendency of the modern Indians to elaborate the game may be traced in the description of "Plumstone shooting" given in "Omaha Sociology" by Rev. J. Owen Dorsey. Third Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution. Washington, 1884, p. 335.

[66] Col. James Smith describes the game among the Wyandots. An Account of the Remarkable Occurrences in the Life and Travels of Col. James Smith, during his Captivity with the Indians in the Years 1755-1759. Cincinnati, 1870, p. 46. Tanner also describes it. He calls it *Beg-ga-sah* or dice. Tanner's Narrative, New York, 1830, p. 114.

can be. The victory belonged to the side which counted amongst its numbers those players who were the fleetest runners, the most skilful throwers and the most adroit dodgers. The second was purely a game of chance. If honestly played no other element entered into its composition. The third which we are now about to consider was much more complicated in its rules than either of the others. It closely resembled in some respects several of our modern gambling games. The French found it very difficult to comprehend and hence the accounts of it which they have given are often confused and perplexing. Boucher[67] says, "Our French people have not yet been able to learn to play it well; it is full of spirit and these straws are to the Indians what cards are to us." Lafitau[68] after quoting from Boucher says, "Baron de la Hontan also made out of it a game purely of the mind and of calculation, in which he who best knows how to add and subtract, to multiply and divide with these straws will surely win. To do this, use and practice are necessary, for these savages are nothing less than good calculators."

"Sieur Perrot, who was a celebrated traveller, and that European whom the savages of New France have most honored, left a description of this game in his manuscript Memorial. I would gladly have inserted it here but it is so obscure that it is nearly unintelligible." Charlevoix admits that he could understand nothing of the game, except as played by two persons in its simplest form and adds that he was told that "there was as much of art as of chance in the game and that the Indians are great cheats at it."[69]

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[67] p. 57. [68] Vol. II, p. 351.

[69] Charlevoix, Vol. III, p. 319; Father Tailhan who edited Perrot says he has not been any more successful than his predecessors and the game of straws remains to him an unsolved enigma. Perrot, Notes to Ch. X, p. 188.

Where Lafitau and Charlevoix, aided by opportunities to investigate the game itself, have failed, it would seem to be useless for us to attempt. Perrot has indeed succeeded in making his account hopelessly involved. There is however much information to be derived from it and the obscure points are after all unimportant unless one should actually wish to reproduce the game in practice. In that event there are many points connected with the counts which would prove troublesome.

To play the game, a number of straws or reeds uniform in size and of equal length were required. They were generally from six to ten inches long. The number used in the game was arbitrary. Lawson puts it at fifty-one. Charlevoix at two hundred and one. The only essential points were that the numbers should be odd and that there should be enough of them so that when the pile was divided into two parts, a glance would not reveal which of the two divisions contained the odd number of straws. In its simplest form, the game consisted, in separating the heap of straws into two parts, one of which each player took, and he whose pile contained the odd number of straws was the winner. Before the division was made the straws were subjected to a manipulation, somewhat after the manner of shuffling cards. They were then placed upon the deer-skin or upon whatever other article was selected as a surface on which to play. The player who was to make the division into two heaps, with many contortions of the body and throwing about of the arms, and with constant utterances to propitiate his good luck, would make a division of the straws with a pointed bone or some similar instrument, himself taking one of the divisions while his adversary took the other. They would then rapidly separate the straws into parcels numbering ten each and determine from the fractional remainders, who had the odd number.

The speed with which this process of counting was carried on was always a source of wonder to the lookers-on, and the fact that the counting was done by tens is almost invariably mentioned. Between two people betting simply on the odd number no further rules were necessary. To determine which had the heap containing the odd number, there was no need to foot up the total number of tens. It was to be settled by what was left over after the last pile of complete tens was set aside. The number itself might be either one, three, five, seven or nine. In the more complicated form of the game, this led to giving different values to these numbers, the nine being always supreme and the one on which the highest bets were wagered. It was generally understood that the holder of this number swept the board taking all bets on other numbers as well as those on the nine. It was easy to bet beads against beads and skins against skins, in a simple game of odd or even, but when the element of different values for different combinations was introduced, some medium of exchange was needed to relieve the complications. Stones of fruit were employed just as chips or counters are used in modern gambling games, and a regular bank was practically instituted. Each player took a certain number of these counters, as the equivalent of the value of the merchandise which he proposed to hazard on the game, whether it was a gun, a blanket, or some other article. Here we have all the machinery of a regular gambling game at cards, but the resemblance does not stop here. The players put up their bets precisely as they now do in a game of faro, selecting their favorite number and fixing the amount, measured in the standard of the game, which they wished to hazard. "By the side of the straws which are on the ground are found the (*grains*) counters," says Perrot, "which the players have bet on the game." In another place, the

method of indicating the bets is stated as follows: "he (meaning apparently the one who has bet) is also obliged to make two other heaps. In one he will place five, in the other seven straws, with as many (*grains*) counters as he pleases." These phrases may fairly be interpreted to mean that a record of the bets, somewhat of the same style as that kept with counters upon a faro table, was constantly before the players. Complicated rules determined when the players won or lost; when the bets were to be doubled and when they were to abide the chance of another count. The loser at the game, even after all that he had with him was gone, was sometimes permitted to continue the game on his promise to pay. If ill luck still pursued him the winner could refuse him credit and decline to play for stakes that he could not see.

The game often lasted for several days, one after another of the sides relieving his comrades at the play until one of the two sides had lost everything, it being, says Perrot,[70] "a maxim of the savages not to quit play until one side or the other had lost everything." Those who had bet at the game had the right to substitute any person whom they pleased to play for them. "Should any dispute arise on this point," says Perrot, "between the winners and the losers, the disputants backed by their respective sides would probably come to blows, blood would be shed and the whole thing would be very difficult to settle." Cheating often took place at this game. Its exposure was considered praiseworthy and its practice denounced. If doubts were expressed as to the accuracy of a count, the matter was peacefully adjusted by a re-count by two of the spectators.

"This game of straw," says Perrot, from whose ac-

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[70] p. 49.

count we have made the foregoing digest, "is ordinarily held in the cabins of the chiefs, which are large, and are, so to speak, the Academy of the Savages." He concludes his account with the statement that the women never play it.[71] The authority on this game whom Ogilby quotes slides over the difficulties of the description with the statement that "many other whimsies be in this game which would be too long to commit to paper." Abbé Ferland[72] epitomizes the results of his investigation of this game as follows: "Memory, calculation and quickness of eyesight were necessary for success."

Like the game of dice or platter it was essentially a house game, and like platter it is rarely mentioned by writers who describe the habits of Indians in the south. Lawson describes it, but in slightly modified form, as follows: "Indian Cards. Their chiefest game is a sort of Arithmetick, which is managed by a parcel of small split reeds, the thickness of a small Bent; these are made very nicely, so that they part, and are tractable in their hands. They are fifty-one in number, their length about seven inches; when they play, they throw part of them to their antagonist; the art is, to discover, upon sight, how many you have, and what you throw to him that plays with you. Some are so expert at their numbers, that they will tell ten times together, what they throw out of their hands. Although the whole play is carried on with the quickest motion it is possible to use, yet some are so expert at this Game, as to win great Indian Estates by this Play. A good sett of these reeds, fit to play withal are valued and sold for a dressed doe-skin."

A. W. Chase[73] speaks of "native games of cards

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[71] See also Shea's Hennepin, p. 300. [72] Vol. I, p. 134.

[73] Overland Monthly, Vol. II, p. 433. Dorsey found a survival of the game in use among the Omahas. He called it "stick counting." Third Annual Report, Bureau of Ethnology, p. 338.

among the Coquelles and Makneatanas, the pasteboards being bundles of sticks." He furnishes no description of the games, but uses the same phrase which was applied by Lawson in North Carolina and by Boucher in Canada.

Frank H. Cushing[74] speaks of a game of "Cane-cards" among the Zuñi which he says "would grace the most civilized society with a refined source of amusement." He was not able fully to comprehend it.

In the list of games, there is none of which we have any detailed account, which compares with straws as played by the northern tribes, in elaborateness of construction. The unfortunate confusion which prevails throughout Perrot's description of the method of counting, and the way in which the point was shirked by all other writers on the subject, prevents any attempt at analysis. So far as we can see, the rules were arbitrary and not based upon any calculations of the laws of chance. If some other detailed account of the game should be discovered it would be interesting to follow up this question and ascertain how far the different combinations which affected the counts were based upon a theory of probabilities and how far they were arbitrary.

It will of course be noticed that the game described by Lawson was relieved from much of this complication. The dexterity required to make a throw of such a nature that the player could tell exactly the number of reeds with which he had parted, was of course remarkable and naturally called forth expressions of surprise. But there were apparently no other combinations resting upon the throw than the simple guess at the number thrown. Travellers in California have described the game in still simpler form in which we see hints of the more complex

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[74] The Century, Vol. XXVI, p. 38. My Adventures in Zuñi.

game. Here the "sticks" were thrown in the air and an immediate guess was made whether the number thrown was odd or even. An umpire kept the account with other sticks and on this count the bets were adjusted.[75]

Wherever we find it and whatever the form in use, whether simple or complicated, like games of lacrosse and platter the occasion of its play was but an excuse for indulgence in the inveterate spirit of gambling which everywhere prevailed.

CHUNKEE OR HOOP AND POLE.

Among the Indians at the south, observers noted and described a game of great antiquity, of which we have no record during historical times among those of the north, unless we should classify the game of javelin described by Morgan[76] as a modified form of the same game. The general name by which this game was known was chunkee. When Iberville arrived at the mouth of the Mississippi he despatched a party to explore the river. The officer who kept the "Journal de la frégate, le Marin" was one of that party and he recorded the fact that the Bayagoulas and Mougoulachas passed the greater part of their time in playing in this place with great sticks which they throw after a little stone, which is nearly round and like a bullet.[77] Father Gravier descended the river in 1700 and at the village of Houmas he saw a "fine level square where from morning to night there are young men who exercise

[75] Kotzebue, A Voyage of Discovery, etc. London, 1821. Vol. I, p. 282 and Vol. III, p. 44, note. W. H. Emory, U. S. and Mexican Boundary Survey, Vol. I, p. 111, says: "The Yumas played a game with sticks like jackstraws." Stanley, Smithsonian Miscellaneous Collections, Vol. II, p. 55, gives among his "Portraits of North American Indians," a picture of a game which he describes as "played exclusively by women. They hold in their hands twelve sticks about six inches in length which they drop upon a rock. The sticks that fall across each other are counted for game."

[76] League of the Iroquois, p. 300. [77] Margry, Découvertes, etc., Vol. 4, p. 261.

themselves in running after a flat stone which they throw in the air from one end of the square to the other, and which they try to have fall on two cylinders that they roll where they think the stone will fall."[78] Adair gives the following description of the same game: "The warriors have another favorite game, called '*chungke*', which, with propriety of language may be called 'Running hard labour.' They have near their state house[79] a square piece of ground well cleaned, and fine sand is carefully strewed over it, when requisite, to promote a swifter motion to what they throw along the surface. Only one or two on a side play at this ancient game. They have a stone about two fingers broad at the edge and two spans round; each party has a pole of about eight feet long, smooth, and tapering at each end, the points flat. They set off abreast of each other at six yards from the end of the playground; then one of them hurls the stone on its edge, in as direct a line as he can, a considerable distance toward the middle of the other end of the square. When they have run a few yards, each darts his pole anointed with bears' oil, with a proper force, as near as he can guess in proportion to the motion of the stone, that the end may lie close to the stone. When this is the case, the person counts two of the game, and, in proportion to the nearness of the poles to the mark, one is counted, unless by measuring, both are found to be at an equal distance from the stone. In this manner, the players will keep running most part of the day, at half speed, under the violent heat of the sun, staking their silver ornaments, their nose-, finger- and ear-rings; their breast-, arm- and wrist-plates, and even all their wearing apparel, except that which barely covers their middle. All the

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[78] Shea's Early Voyages, Albany, 1861, p. 143.

[79] Consult E. G. Squier.—Aboriginal Monuments of N. Y., Smithsonian Contributions to Knowledge, Vol. II, pp. 135-6 and note p. 136.

American Indians are much addicted to this game, which to us appears to be a task of stupid drudgery; it seems, however, to be of early origin, when their forefathers used diversions as simple as their manners. The hurling stones they use at present were from time immemorial rubbed smooth on the rocks and with prodigious labor; and they are kept with the strictest religious care, from one generation to another, and are exempted from being buried with the dead. They belong to the town where they are used, and are carefully preserved."[80]

Lieut. Timberlake[81] describes the game as he saw it played among the Cherokees where it was known by the name of "Nettecawaw." "Each player has a pole about ten feet long, with several marks or divisions. One of them bowls a round stone with one flat side, and the other convex, on which the players all dart their poles after it, and the nearest counts according to the vicinity of the bowl to the marks on his pole."

Romans saw it among the Choctaws. He says, "The manner of playing the game is thus: they make an alley of about two hundred feet in length, where a very smooth clayey ground is laid, which when dry is very hard: they play two together having each a straight pole about fifteen feet long; one holds a stone which is in the shape of a truck, which he throws before him over this alley, and the instant of its departure, they set off and run; in running they cast their poles after the stone; he that did not throw it endeavors to hit it; the other strives to strike the pole of his antagonist in its flight so as to prevent the pole of his opponent hitting the stone. If the first should strike the stone he counts one for it, and if the other by the

[80] See also Historical Collections, Louisiana and Florida. B. F. French [Vol. II.], second series, p. 74. New York, 1875.

[81] Memoirs of Lieut. Henry Timberlake, etc., London, 1765, p. 77.

dexterity of his cast should prevent the pole of his opponent hitting the stone, he counts one, but should both miss their aim the throw is renewed."

Le Page du Pratz[82] describes the game as practised among the Natchez. He calls it "*Le Jeu de la Perche* which would be better named *de la crosse.*" Dumont who was stationed at Natchez and also on the Yazoo, describes the game and speaks of it as "La Crosse."[83]

Adair is correct when he speaks of the antiquity of this game. When he dwells upon the fact that these stones are handed down from generation to generation, as the property of the village, he brings these tribes close to the mound dwellers. Squier,[84] speaking of discoidal stones, found in the mounds, says, "It is known that among the Indian tribes of the Ohio and along the Gulf, such stones were in common use in certain favorite games." Lucien Carr[85] describes and pictures a chunkee stone from Ely Mound, Va. Lewis and Clarke[86] describe the game as played among the Mandans. This tribe had a wooden platform prepared on the ground between two of their lodges. Along this platform the stone ring was rolled and the sticks were slid along the floor in pursuit of it. Catlin[87] describes the game as played by the same tribe. They had a carefully prepared pavement of clay on which they played. The "Tchunkee" sticks were marked with bits of leather and the counts of the game were affected by the position of the leather on or near which the ring lodged.

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[82] Histoire de la Louisiane, Paris, 1758, Vol. III, p. 2.

[83] Mémoires Historiques sur la Louisiane, Paris, 1753, Vol. I, p. 202.

[84] Ancient Monuments of the Mississippi Valley, p. 223.

[85] 10th Annual Report Peabody Museum, p. 93. See also Schoolcraft's Indian tribes, Vol. I, p. 83.

[86] Lewis and Clarke's Expedition, Phila., 1814, Vol. I, p. 143.

[87] Vol. I, p. 132 *et seq.* Dorsey describes two forms of the game in use among the Omahas: "shooting at the rolling wheel" and "stick and ring." Third Annual Report, Bureau of Ethnology, pp. 335-336. *cf.* Travels in the Interior of America, in the years 1809, 1810 and 1811, by John Bradbury, p. 126.

The Mojaves are accustomed to play a similar game which has been described under the name "Hoop and Pole".[88] A similar game was played by the Navajoes.[89]

The Yumas played a game with two poles fifteen feet long and a ring a few inches in diameter.[90] Kane[91] says that the Chualpays at Fort Colville on the Columbia "have a game which they call '*Alkollock*,' which requires considerable skill. A smooth, level piece of ground is chosen, and a slight barrier of a couple of sticks placed lengthwise is laid at each end of the chosen spot, being from forty to fifty feet apart and only a few inches high. The two players, stripped naked, are armed with a very slight spear, about three feet long, and finely pointed with bone; one of them takes a ring made of bone or some heavy wood and wound with cord. The ring is about three inches in diameter, on the inner circumference of which are fastened six beads of different colors, at equal distances, to each of which a separate value is attached. The ring is then rolled along the ground to one of the barriers and is followed at the distance of two or three yards by the players, and as the ring strikes the barrier and is falling on its side, the spears are thrown, so that the ring may fall on them. If any one of the spears should be covered by the ring, the owner counts according to the colored bead on it. But it generally happens from the dexterity of the players that the ring covers both spears and each counts according to the color of the beads above his spear. They then play towards the other

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[88] Lieut. A. W. Whipple in Pac. R. R. Rep., Vol. III, p. 114; Harper's Mag., Vol. XVII, p. 463; Domenech, Vol. II, p. 197; H. H. Bancroft's Native Races, Vol. I, p. 393, p. 517 and note 133. The Martial Experiences of the California Volunteers by Edward Carlsen, Overland, Vol. VII, No. 41, 2nd Series, p. 494.

[89] Major E. A. Backus in Schoolcraft, Vol. IV, p. 214.

[90] W. H. Emory, U. S. and Mexican Boundary Survey, Vol. I, p. 111.

[91] Kane's Wanderings, p. 310; H. H. Bancroft's Native Races, Vol. I, p. 280.

barrier, and so on until one party has obtained the number agreed upon for the game."

In his "Life among the Apaches,"[92] Colonel Cremony describes the hoop and pole game as played by the Apaches. With them the pole is marked with divisions throughout its whole length and these divisions are stained different colors. The object of the game is to make the hoop fall upon the pole as near the butt as possible, graduated values being applied to the different divisions of the pole. The women are not permitted to approach within a hundred yards while the game is going on.[93]

Those who have described this game in the various forms in which it has been presented dwell upon the fact that it taxed the strength, activity and skill of the players. In this respect it rivalled lacrosse. In geographical range the territory in which it was domesticated was nearly the same.

There are many, doubtless, who would decline to recognize the discoidal stones of the mounds as chunkee stones, but it can not be denied that the "*nettecawaw*" of the Cherokees[94], the "hoop and pole" of the Mojaves and Apaches[95], the second form of "spear and ring" described by Domenech,[96] the "*alkollock*" of the Chualpays[97] and the chunkee of Romans and Adair are the same game.

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[92] Life among the Apaches, by John C. Cremony, p. 302.

[93] The Hawaiians were accustomed to hurl a piece of hard lava along narrow trenches prepared for the purpose. The stone which was called Maika closely resembled a chunkee stone. It is described as being in the shape of a small wheel or roller, three inches in diameter and an inch and a half thick, very smooth and highly polished. This game appears to have been limited to a contest of skill in rolling or hurling the stone itself. The additional interest which was given by hurling the spears at it while in motion was wanting. Narrative of the U. S. Exploring Expedition by Charles Wilkes, London, 1845, Vol. IV, p. 55.

[94] Timberlake, p. 77.

[95] Whipple, Pac. R. R. Rep., Vol. III, p. 114; Cremony, p. 302; Harper's Mag., Vol. XVII, p. 463.

[96] Domenech, Vol. II, p. 197. [97] Kane's Wanderings, p. 310.

The change from the discoidal stone to the ring; the different materials of which the ring is made, whether of stone,[98] of bone,[99] of wood,[100] or of cord;[101] whether wound with cord[102] or plain; the different lengths of the spears varying from three feet[103] to ten feet[104] and even reaching fifteen feet in length among the Mojaves;[105] the different markings of the spear[106] and the ring;[107] the different ways of preparing the ground, whether tamping with clay,[108] or flooring with timber,[109] or simply removing the vegetation,[110] — all these minor differences are of little consequence. The striking fact remains that this great number of tribes, so widely separated, all played a game in which the principal requirements were, that a small circular disk should be rolled rapidly along a prepared surface and that prepared wooden implements, similar to spears, should be launched at the disk while in motion or just at the time when it stopped. Like lacrosse, it was made use of as an opportunity for gambling, but owing to the restriction of the ground on which it could be played, the number of players were limited, and to that extent the interest in the contests and the excitement attendant upon them were proportionally reduced.

OTHER ATHLETIC GAMES.

In addition to the games of lacrosse, platter or dice, straws and chunkee, there were other games, some of an athletic nature, some purely of chance, which observers have described, some of which are mentioned only in

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[98] Lewis and Clarke, Vol. I, p. 143; Catlin, Vol. I, p. 132.
[99] Kane's Wanderings, p. 310. [100] Cremony, p. 302.
[101] Whipple, Pac. R. R. Rep., Vol. III, p. 114. [102] Kane's Wanderings, p. 310.
[103] Ibid. [104] Timberlake, p. 77; Cremony, p. 302.
[105] Whipple, Pac. R. R. Rep., Vol. III, p. 114.
[106] Cremony, p. 302; Domenech, Vol. II, p. 197; Timberlake, p. 77.
[107] Kane's Wanderings, p. 310. [108] Catlin, Vol. I, p. 132.
[109] Lewis and Clarke, Vol. I, p. 143. [110] Domenech, Vol. II, p. 197.

limited areas, while others, like the games above mentioned, were played by Indians scattered over a wide territory and apparently having but little in common. Some of these games were but modified forms of those which have been already described. Such, for instance, is a game of ball which is described by Lafitau[111] and by Charlevoix.[112] This closely resembled lacrosse in its general methods of play, but as no rackets were used, it was less dangerous and less exciting. Goals were erected at each end of the field, separated by five hundred paces according to Lafitau. The players were divided into sides. The ball was tossed into the air in the centre of the field. When it came down the players of each side strove to catch it. He who was successful ran in the direction of the goal which he wished to reach. The players of the opposide side pursued him and did what they could to prevent him from accomplishing his object. When it was evident that the runner could gain no more ground, he would pass the ball, if possible, to some player upon the same side and his success in accomplishing this was dependent largely upon his skill. The game is probably not so old as lacrosse, for the ball is described as being larger and softer than the one used in lacrosse, thus indicating that it belonged to the period when the stuffed deer-skin ball was used in that game.

Both Dumont and Le Page du Pratz describe this game with this difference,[113] that the ball, according to their descriptions, was incessantly tossed in the air. Romans says that this game was played among the women; and Lafitau, who describes it separately, adds that in this form it was only played by girls. He also says that the Abenakis indulged in a similar game, using an inflated bladder

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[111] Lafitau, Vol. II, p. 353. [112] Charlevoix, Vol. III, p. 319.
[113] Dumont, Vol. I, p. 201; LePage, Vol. I, p. 378.

for a ball; and that the Florida Indians fixed a willow cage upon a pole in such a way that it could revolve and tried to hit it with a ball so as to make it turn several times.[114]

Joutel in his historical journal describes a curious game as follows: "Taking a short stick, very smooth and greased that it may be the harder to hold it fast, one of the elders throws it as far as he can. The young men run after it, snatch it from each other, and at last, he who remains possessed of it has the first lot."[115]

Foot ball is found at the north. Ogilby[116] says: "Their goals are a mile long placed on the sands, which are as even as a board; their ball is no bigger than a hand ball, which sometimes they mount in the air with their naked feet, sometimes it is swayed by the multitude, sometimes also it is two days before they get a goal, then they mark the ground they win, and begin there the next day. Before they come to this sport they paint themselves, even as when they go to war." At the south it was "likewise a favorite manly diversion with them."[117]

Certain forms of ball-play which were neither lacrosse nor chunkee, but which resembled these games were found in different localities. Such for instance is the game which Catlin[118] saw played by the Sioux women. Two balls were connected with a string a foot and a half long. Each woman was armed with a stick. They were divided into equal sides. Goals were erected and the play was in some respects like lacrosse. Stakes were wagered on the game. This game is also described by Domenech,[119] who says the women wore a special costume which left the limbs free and that

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114 Lafitau, Vol. II, p. 358.

115 French's Historical Collections of Louisiana, Vol. I, p. 188; Sanford's History of the United States before the Revolution, p. clxxxii.

116 Ogilby, Book II, Chap. II, p. 156. See also Smith's Narrative, p. 77.

117 Bartram, p. 509. 118 Vol. II, p. 146. 119 Vol. II, p. 196.

the game was "unbecoming and indecent." Powers[120] found a game among the Nishinams, on the western slope of the Sierra Nevada, not far from Sacramento, which in some respects also resembled lacrosse. He says "The '*Ti'-kel*' is the only really robust and athletic game they use, and is played by a large company of men and boys. The piece[121] is made of raw-hide or nowadays of strong cloth, and is shaped like a small dumb-bell. It is laid in the centre of a wide, level space of ground, in a furrow, hollowed out a few inches in depth. Two parallel lines are drawn equidistant from it, a few paces apart, and along these lines the opposing parties, equal in strength, range themselves. Each player is equipped with a slight, strong staff, from four to six feet long. The two champions of the party take their stations on opposite sides of the piece, which is thrown into the air, caught on the staff of one of the others, and hurled by him in the direction of his antagonist's goal. With this send-off there ensues a wild chase and a hustle, pell-mell, higgledy-piggledy, each party striving to bowl the piece over the other's goal. These goals are several hundred yards apart.

In an article in the Overland Monthly, [122] A. W. Chase describes a game in vogue among the Oregon Indians which he says was identical with hockey, as follows : "Sides being chosen, each endeavors to drive a hard ball of pine wood around a stake and in different directions ; stripped to the buff, they display great activity and strength, whacking away at each other's shins, if they are in the way, with a refreshing disregard of bruises. The squaws assist in the performance by beating drums and keeping up a monotonous chant."

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[120] Contributions to North American Ethnology, Vol. III, p. 333.
[121] The equivalent in the game, of the ball in lacrosse.
[122] Vol. II, p. 433. See also Smith's Narrative, p. 77

In the first of the two games of "spear and ring," described by Domenech,[123] the players are divided into sides. The stone ring, about three inches in diameter, is fixed upright on the chosen ground, and players two at a time, one from each side, endeavor to throw their spears through the ring. The spears are marked along their length with little shields or bits of leather, and the count is affected by the number of these that pass through the ring. He also mentions a game[124] among the Natchez in which the ring was a "huge stone" and the spear a "stick of the shape of a bat."

If we classify Domenech's first game of "spear and ring" among those which resemble chunkee, rather than as a form of chunkee itself, we shall probably be compelled to pursue the same course with Morgan's game of "javelin" to which we have already alluded.[125] In this game the players divided into sides. Each player had an agreed number of javelins. The ring, which was either a hoop or made solid like a wheel by winding with splints, was about eight inches in diameter. The players on one side were arranged in a line and the hoop was rolled before them. They hurled their javelins. The count of the game was kept by a forfeiture of javelins. Such as hit the mark were safe, but the javelins which did not hit were passed to the players of the other side who then had an opportunity to throw them at the hoop from the same spot. If these players were successful the javelins were forfeited and laid out of the play. If, however, they in turn failed the javelins were returned to their original owners. The hoop was then rolled by the other side and the process continued until one of the sides had forfeited all their javelins.

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[123] Vol. II, pp. 197-8.

[124] He does not give his authority for this game. He has evidently copied in his book from other writers, but seldom indicates whether his descriptions are based upon personal observation or quoted.

[125] League of the Iroquois, p. 300.

OTHER GAMES OF CHANCE.

There was diversity in the forms of the games of simple chance as well as in the athletic games, and besides those which have been already described, the Indians on the Pacific Coast had a great variety of games, or forms of the same game, in which, in addition to the element of chance involved in determining the numbers or positions of certain sticks or counters, there was also an opportunity for the player who was manipulating them to deceive by dexterous sleight of hand. The simplest form in which this is found is guessing in which hand a small stone or bone is held. It would hardly seem that this artless effort could be transformed into an amusing and exciting game; yet it has attracted the attention of all travellers, and scarcely any writer, who treats of the habits of the Pacific coast Indian, fails to give a full account of this simple game. Lewis and Clarke,[126] when writing about the Indians near the mouth of the Columbia, say: "The games are of two kinds. In the first, one of the company assumes the office of banker and plays against the rest. He takes a small stone, about the size of a bean, which he shifts from one hand to another with great dexterity, repeating at the same time a song adapted to the game and which serves to divert the attention of the company, till having agreed on the stakes, he holds out his hands, and the antagonist wins or loses as he succeeds or fails at guessing in which hand the stone is. After the banker has lost his money or whenever he is tired, the stone is transferred to another, who in turn challenges the rest of the company.[127] In the

[126] Lewis and Clarke, Vol. II, 140; and also II, 94.

[127] See also, Adventures on the Columbia River, by Ross Cox, p. 158; The Oregon Territory, by John Dunn, p. 93; Four Years in British Columbia, by Commander R. C. Mayne, p. 275; it was played by the Comanches in Texas with a bullet, Robert S. Neighbors in Schoolcraft, Vol. II, p. 133; by the Twanas with one or two bones, Bulletin U. S. Geol. Survey, Vol. III, No. 1, p. 89, Rev. M. Eels.

account given by George Gibbs[128] the count of the game among the tribes of western Washington and northwestern Oregon, was kept by means of sticks. Each side took five or ten small sticks, one of which was passed to the winner on each guess, and the game was ended when the pile of one side was exhausted. According to him, "The backers of the party manipulating keep up a constant drumming with sticks on their paddles which lie before them, singing an incantation to attract good fortune." Powers describes another form into which the game developed among the Indians of central California. It is "played with a bit of wood or a pebble which is shaken in the hand, and then the hand closed upon it. The opponent guesses which finger (a thumb is a finger with them) it is under and scores one if he hits, or the other scores if he misses. They keep tally with eight counters."[129]

Schwatka, in his recent exploration of the Yukon found this game among the Chilkats. It was called *la-hell*. Two bones were used. One was the king and one the queen. His packers gambled in guessing at the bones every afternoon and evening after reaching camp.[130]

The simplicity of the game was modified by the introduction of similar articles in each hand, the question to be decided being in which hand one of them having a specified mark should be found. Kane[131] thus describes such a game among the Chinooks: "Their games are few. The one most generally played amongst them consists in holding in each hand a small stick, the thickness of a goose quill, and about an inch and one-half in length, one plain, the other distinguished by a little thread wound round

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[128] Contributions to North American Ethnology, Vol. I, p. 206.
[129] Contributions to North American Ethnology, Vol. III, pp. 332-3.
[130] Along Alaska's Great River. By Frederic Schwatka, p. 71.
[131] Kane's Wanderings, p. 189.

it, the opposite party being required to guess in which hand the marked stick is to be found. A Chinook will play at this simple game for days and nights together, until he has gambled away everything he possesses, even to his wife."[132]

Among the Utahs this form of the game was common: "A row of players consisting of five or six or a dozen men is arranged on either side of the tent facing each other. Before each man is placed a bundle of small twigs or sticks each six or eight inches in length and pointed at one end. Every tête-à-tête couple is provided with two cylindrical bone dice carefully fashioned and highly polished which measure about two inches in length and half an inch in diameter, one being white and the other black, or sometimes ornamented with a black band." At the rear, musicians were seated who during the game beat upon rude drums.[133] In this game it will be noticed that the players paired off and apparently each man played for himself.

Still another element is introduced in another form of the game, which increases the opportunity afforded the one who manipulates the bones for dexterity. This form of the game is repeatedly alluded to by Powers. While relating the habits and customs of the Gualala, whose homes were near Fort Ross, he describes what he calls the gambling game of "*wí* and *tep*" and says that one description with slight variations will answer for nearly all the tribes of central and southern California. After describing the making up of the pool of stakes, he adds: "They gamble with four cylinders of bone about two inches long, two of which are plain, and two marked with rings and strings tied round the middle. The game is conducted by four old and ex-

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[132] See also, Overland, Vol. IX, p. 163, Powers; H. H. Bancroft's Native Races, Vol. I, p. 244; Clay balls are sometimes used, Ibid, Vol. I, p. 353; The Northwest Coast, James G. Swan, p. 158; Montana as it is, Granville Stuart, p. 71.

[133] Edwin R. Barker in the American Naturalist, June, 1877, Vol. XI, p. 551.

perienced men, frequently grey heads, two for each party, squatting on their knees on opposite sides of the fire. They have before them a quantity of fine dry grass, and with their hands in rapid and juggling motions before and behind them, they roll up each piece of bone in a little ball and the opposite party presently guess in which hand is the marked bone. Generally only one guesses at a time, which he does with the word '*tep*' (marked one), and '*wi*' (plain one). If he guesses right for both players, they simply toss the bones over to him and his partner, and nothing is scored on either side. If he guesses right for one and wrong for the other, the one for whom he guessed right is 'out', but his partner rolls up the bones for another trial, and the guesser forfeits to them one of his twelve counters. If he guesses wrong for both, they still keep on and he forfeits two counters. There are only twelve counters and when they have been all won over to one side or the other, the game is ended."[134] Sometimes the same game was played without going through the formality of wrapping the pieces in grass, simply shaking them in the hands as a preliminary for the guessing.[135]

A slightly different method prevails among the Indians of Washington and northwestern Oregon. Ten disks of hard wood, each about the diameter of a Mexican dollar and somewhat thicker, are used. "One of these is marked and called the chief. A smooth mat is spread on the ground, at the ends of which the opposing players are seated, their friends on either side, who are provided with the requisites for a noise as in the other case. The party holding the disks has a bundle of the fibres of the cedar

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[134] Powers in Contributions to North American Ethnology, Vol. III, pp. 90-152; 189-332.

[135] Contributions to North American Ethnology, Vol. III, 332; Alexander Ross's Adventures, pp. 308, 309.

bark, in which he envelops them, and after rolling them about, tears the bundle into two parts, his opponent guessing in which bundle the chief lies."[136] The same game is described by Kane, except that the counters, instead of being wrapped in one bundle which is afterward torn in two, are originally wrapped in two bundles.[137]

Still another complication of the guessing game was described by Mayne.[138] Blankets were spread upon the ground on which sawdust was spread about an inch thick. In this was placed the counter, a piece of bone or iron about the size of a half a crown, and one of the players shuffled it about, the others in turn guessing where it was.

The game of "moccasin" was but a modification of this game. As described by Philander Prescott three moccasins were used in this game by the Dacotas. The bone or stick was slipped from one to another of the moccasins by the manipulators, and the others had to guess in which moccasin it was to be found. Simple as this description seems, the men would divide into sides, playing against each other, and accompanying the game with singing.[139]

Among the Zuñis, the guessing game was exalted to the nature of a sacred festival. Frank H. Cushing[140] gives the following account of its practice. "One morning the two chief priests of the bow climbed to the top of the houses, and just at sunrise called out a 'prayer message' from the mount-environed gods. Eight players went into a *kli-wi-tain* to fast, and four days later issued forth, bearing four large wooden tubes, a ball of stone, and a bundle of thirty-six counting straws. With great ceremony, many

136 Contributions to North American Ethnology, Gibbs, Vol. I, p. 206.

137 Kane's Wanderings, p. 189; Swan's Northwest Coast, p. 157; Eels in Bulletin U. S. G. Surv., Vol. III, No. 1.

138 Mayne's British Columbia, p. 275.

139 Schoolcraft, Vol. IV, p. 64; Domenech, Vol. II, p. 192.

140 The Century, Vol. XXVI, p. 37.

prayers and incantations, the tubes were deposited on two mock mountains of sand, either side of the 'grand plaza.' A crowd began to gather. Larger and noisier it grew, until it became a surging, clamorous, black mass. Gradually two piles of fabrics, —vessels, silver ornaments, necklaces, embroideries, and symbols representing horses, cattle and sheep— grew to large proportions. Women gathered on the roofs around, wildly stretching forth articles for betting, until one of the presiding priests called out a brief message. The crowd became silent. A booth was raised, under which two of the players retired; and when it was removed the four tubes were standing on the mound of sand. A song and dance began. One by one three of the four opposing players were summoned to guess under which tube the ball was hidden. At each guess the cries of the opposing party became deafening, and the mock struggles approached the violence of combat. The last guesser found the ball; and as he victoriously carried the latter and the tubes across to his own mound, his side scored ten. The process was repeated. The second guesser found the ball; his side scored fifteen setting the others back five. The counts numbered one hundred; but so complicated were the winnings and losings on both sides, with each guess of either, that hour after hour the game went on, and night closed in. Fires were built in the plaza, cigarettes were lighted, but still the game continued. Noisier and noisier grew the dancers; more and more insulting and defiant their songs and epithets to the opposing crowd, until they fairly gnashed their teeth at one another, but no blows. Day dawned upon the still uncertain contest; nor was it until the sun again touched the western horizon, that the hoarse, still defiant voices died away, and the victorious party bore off their 'mountains of gifts from the gods.' "

The picturesque description of Cushing brings before our eyes the guessing game in its highest form of development. Among the tribes of the East, if it had a home at all, it was practised in such an inobtrusive way as not to attract the attention of writers who have described their habits and customs. The nearest approach to it which we can find is a guessing game described by Hennepin, as follows: "They take kernels of Indian corn or something of the kind, then they put some in one hand, and ask how many there are. The one who guesses wins."

Mackenzie[141] fell in with some Indians near the Pacific coast who travelled with him a short distance. They carried with them the implements for gambling. Their game was different from the guessing games which have been heretofore described. "There were two players and each had a bundle of about fifty small sticks neatly polished, of the size of a quill, and five inches long. A certain number of their sticks had red lines round them and as many of these as one of the players might find convenient were curiously rolled up in dried grass, and according to the judgment of his antagonist respecting their number and marks he lost or won."

The same game was seen at Queen Charlotte Islands by Francis Poole.[142] He says there were in this game from "forty to fifty round pins or pieces of wood, five inches long by one-eighth of an inch thick, painted in black and blue rings and beautifully polished." These pins were divided into two heaps under cover of bark fibre and the opposite player guessed odd or even for one of the piles.

CONTESTS OF SKILL.

Lewis and Clarke[143] describe a game among the Oregon Indians which can neither be called an athletic game

[141] Alexander Mackenzie's Voyages in 1789 and 1793. London, 1801, p. 311.
[142] Queen Charlotte Islands, a narrative, etc., p. 325. [143] Vol. II, p. 140.

nor a game of chance, but which seems to have been a simple contest of skill. "Two pins are placed on the floor, about the distance of a foot from each other, and a small hole made behind them. The players then go about ten feet from the hole, into which they try to roll a small piece, resembling the men used at draughts; if they succeed in putting it into the hole, they win the stake; if the piece rolls between the pins, but does not go into the hole, nothing is won or lost; but the wager is wholly lost if the chequer rolls outside the pins."

Morgan[144] describes a winter contest of skill among the Iroquois, which he calls snow-snake. The so-called snakes were made of hickory. They were from five to seven feet in length, a quarter of an inch in thickness, tapering from an inch in width at the head to about half an inch at the tail. The head was round, turned up slightly and weighted with lead. This implement was shot along the snow crust, by hand, with great speed, and a point in the game was gained by the snake which ran the greatest distance. When there were a number of players divided into sides, if there were two, three or more snakes of the same side which were in advance of the snakes of the other side, all such counted. Such contests usually took place between tribes and aroused a great degree of spirit and the usual amount of betting. In simpler form, Sagard Theodat describes this kind of amusement.

OTHER AMUSEMENTS OF WOMEN AND CHILDREN.

Under the name of "*Fuseaux*," La Potherie[145] describes a similar winter game of the children. He further says the women only played at platter or dice. The children

[144] League of the Iroquois, p. 303. [145] Vol. III, p. 24.

played at lacrosse, seldom at platter. We have seen that the women in some parts of the country joined in the lacrosse games. Sometimes they played it by themselves and sometimes they played other ball games which closely resemble that game. Romans describes a woman's game in which they tossed up a ball which was to be caught before it reached the ground; but in the meantime the one who tossed it had to pick up a small stick from the ground.

The women of the Natchez[146], according to Le Page du Pratz, played with three pieces of cane, each eight or nine inches long, flat on one side and convex on the other with engravings on the convex side. Two were held in the open palm of the left hand and the third was dropped round side down upon the ends of the two, so that all would fall to the ground. If two convex surfaces came up the player won. He also says, and in this Romans concurs, that the women were very reluctant to be seen while playing.

Among the Natchez, the young girls played ball with a deer-skin ball stuffed with Spanish moss. Other than that they seemed to him to have no games.[147] The young Choctaws, according to Romans, engaged in wrestling, running, heaving and lifting great weights and playing ball. Hennepin says, "the children play with bows and with two sticks, one large and one small. They hold the little one in the left, and the larger one in the right hand, then with the larger one they make the smaller one fly up in the air, and another runs after it, and throws it at the one who sprang it. They also make a ball of flags or corn leaves, which they throw in the air and catch on the end of a pointed stick."

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[146] La Page du Pratz, Vol. III, p. 2; Domenech, Vol. II, p. 192.
[147] Le Page du Pratz, Vol. III, p. 2.

Powers[148] describes a game among the children of the Nishinams which consisted in tossing bunches of clover from one to another, and another in which the boys placed themselves upon three bases and tossed a ball across from one to the other. Points were won as in base ball by running bases, if possible, without being put out by the one who at the time had the ball. The Choctaw[149] boys made use of a cane stalk, eight or nine feet in length, from which the obstructions at the joints had been removed, much as boys use what is called a putty blower. The Zuñi children are said to play checkers with fragments of pottery on flat stones.[150]

Running matches, swimming, wrestling, the simple ball-games which are hinted at rather than described, practice in archery and hurling the spear or javelin, furnished the Indian youth with such amusements as could be derived outside the contests in which his elders participated. Most of these latter were so simple as to be easily understood by the very young, and we can readily comprehend how deeply the vice of gambling must have been instilled in their minds, when they saw it inaugurated with such solemn ceremonials and participated in with such furor by their elders.

Our information concerning the habits of the Indians comes from a variety of sources. Some of it is of very recent date, especially that which deals with the Indians of the Pacific coast. The early Relations of the French Fathers were faithful, and, as a rule, intelligent records of events which the priests themselves witnessed. The accounts of the French and Indian traders and travellers

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148 Contributions to North American Ethnology, Vol. III p. 331.
149 Romans, p. 79; Bossu, Vol. I, p. 306.
150 The Century, Vol. XXVI, p. 28, Cushing.

are neither as accurate nor as reliable as those contained in the Relations. Some of these authors faithfully recorded what they saw; others wrote to make books. They differ widely in value as authorities and must be judged upon their individual merits.

Much of our information concerning the manners and customs of the natives of the Pacific coast is derived from the publications of our national government. The reports which are collated in these documents are from a great number of observers and are not uniform in character, but many of them have great value. As a whole, the work was well done and in a scientific manner.

The narration of the different games tells its own story. Lacrosse is found throughout the country; platter or dice is distributed over an area of equal extent; chunkee was a southern and western game; straws a northern game with traces of its existence in the west; the guessing game was apparently a western game. Everywhere, gambling prevailed to the most shocking extent.

There are writers who seek to reduce the impressions of the extravagance indulged in by the Indians at these games. The concurrence of testimony is to the effect that there was no limit to which they would not go. Their last blanket or bead, the clothing on their backs, their wives and children, their own liberty were sometimes hazarded; and if the chances of the game went against them the penalty was paid with unflinching firmness. The delivery of the wagered wives, Lescarbot tells us, was not always accomplished with ease, but the attempt would be faithfully made and probably was often successful. Self-contained as these people ordinarily were, it is not a matter of surprise that the weaker among them should have been led to these lengths of extravagance, under the high

pressure of excitement which was deliberately maintained during the progress of their games.[151] From one end of the land to the other these scenes were ushered in with ceremonies calculated to increase their importance and to awaken the interest of the spectators. The methods used were the same among the confederations of the north and of the south; among the wandering tribes of the interior; among the dwellers in the Pueblos; and among the slothful natives of the Pacific coast.

The scene described by Cushing, where, at the summons of the "prayer-message," the Zuñis gathered upon the house-tops and swarmed in the Plaza, to hazard their property, amid prayers and incantations, upon a guess under which tube the ball was concealed, is widely different from that depicted by the Jesuit Fathers in Canada, where the swarthy Hurons assembled in the Council House at the call of the medicine man and in the presence of the sick man, wagered their beads and skins, upon the

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[151] The following extracts will illustrate these points: They will bet all they have, even to their wives. It is true, however, that the delivery of the wagered women is not easy. They mock the winners and point their fingers at them (Lescarbot, Vol. III, p. 754); all that they possess, so that if unfortunate, as sometimes has happened, they return home as naked as your hand (Lalemant Relation, 1639); their goods, their wives, their children (Ferland Vol. I, p. 134); some have been known to stake their liberty for a time (Charlevoix, Vol. III, 319); have been known to stake their liberty upon the issue of these games, offering themselves to their opponents in case they get beaten (Catlin, Vol. I, p. 132); I have known several of them to gamble their liberty away (Lawson, p. 176); a Canadian Indian lost his wife and family to a Frenchman (Sagard Theodat, Histoire du Canada Vol. I, p. 243); they wager their wives (A. Colquhon Grant, Journal Royal Geog. Soc., London,Vol. XXVII, p. 299); their wives and children (Irving's Astoria, Vol. II, p. 91); their liberty (Parker's Journal of an Exploring Tour, pp. 249–50); Domenech has never known men to bet their wives (Vol. II, p. 191); women bet as well as men (Romans, p. 79; Am. Naturalist, Vol. XI, No. 6, 551); Philander Prescott (Schoolcraft, Vol. IV, p. 64); Cushing (Century, Vol. XXVI, p. 28); the liberty of a woman wagered by herself (Lalemant, Relation 1639); women are never seen to bet (Le Page du Pratz, Vol. III, p. 2; Mayne Br. Col., p. 276); rash gambling sometimes followed by suicide (Romans p. 79; Brebeuf, Relation 1636).

cast of the dice. It differs equally from the scene which travellers have brought before our eyes, of the Chinooks, beating upon their paddles and moaning forth their monotonous chants, while gathered in a ring about the player, who with dexterous passes and strange contortions manipulated the stone and thus added zest to the guess which was to determine the ownership of the property staked upon the game. The resemblances in these scenes are, however, far more striking than the differences. Climate and topography determine the one. Race characteristics are to be found in the other.

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ANCIENT AND MODERN METHODS OF ARROW-RELEASE.

BY EDWARD S. MORSE.

When I began collecting data illustrating the various methods of releasing the arrow from the bow as practiced by different races, I was animated only by the idlest curiosity. It soon became evident, however, that some importance might attach to preserving the methods of handling a weapon which is rapidly being displaced in all parts of the world by the musket and rifle. While tribes still survive who rely entirely on this most ancient of weapons, using, even to the present day, stone-tipped arrows, there are other tribes using the rifle where the bow still survives. There are, however, entire tribes and nations who have but recently, or within late historic times, abandoned the bow and arrow, its survival being seen only as a plaything for children.

It was not till I had accumulated quite a collection of sketches and other memoranda illustrating the methods of arrow-release, not only of existing but of ancient races, as shown by frescos and rock sculpture, that I realized that even so trivial an art as that of releasing the arrow

might possibly lead to interesting results in tracing the affinities of past races.

I am led to publish the data thus far collected, incomplete as they are, with the intention of using the paper in the form of a circular to send abroad, with the hope of securing further material for a more extended memoir on the subject.

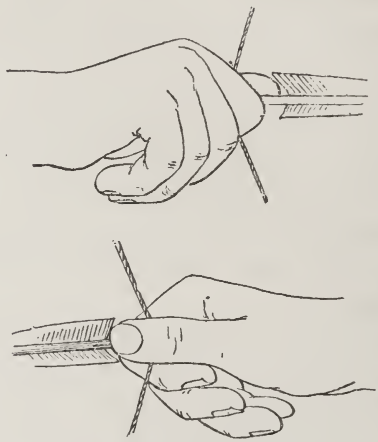
My interest in the matter was first aroused by having a Japanese friend shoot with me. Being familiar with the usual rules of shooting as practiced for centuries by the English archers, and not being aware of more than one way of properly handling so simple and primitive a weapon as the bow and arrow, it was somewhat surprising to find that the Japanese practice was in every respect totally unlike ours. To illustrate: in the English practice, the bow must be grasped with the firmness of a smith's vice; in the Japanese practice, on the contrary, it is held as lightly as possible; in both cases, however, it is held vertically, but in the English method the arrow rests on the left of the bow, while in the Japanese method it is placed on the right. In the English practice a guard of leather must be worn on the inner and lower portion of the arm to receive the impact of the string; in the Japanese practice no arm-guard is required, as by a curious fling or twirl of the bow hand, coincident with the release of the arrow, the bow (which is nearly circular in section) revolves in the hand, so that the string brings up on the outside of the arm where the impact is so light that no protection is needed. In the English method the bow is grasped in the middle, and consequently the arrow is discharged from a point equidistant from its two ends, while the Japanese archer grasps the bow near its lower third and discharges the arrow from this point. This altogether unique method, so far as I am aware, probably arose from the custom of the archers in feudal times

shooting in a kneeling posture from behind thick wooden shields which rested on the ground. While all these features above mentioned are quite unlike in the two peoples, these dissimilarities extend to the method of drawing the arrow and releasing it. In the English method the string is drawn with the tips of the first three fingers, the arrow being lightly held between the first and second fingers, the release being effected by simply straightening the fingers and at the same time drawing the hand back from the string; in the Japanese method of release the string is drawn back by the bent thumb, the forefinger aiding in holding the thumb down on the string, the arrow being held in the crotch at the junction of the thumb and finger.

These marked and important points of difference between the two nations in the use of a weapon so simple and having the same parts,— namely, an elastic stick, a simple cord, a slender barbed shaft,— and used by the two hands, naturally led me to inquire further into the use of the bow in various parts of the world, and to my amazement I found not only a number of totally distinct methods of arrow-release with modifications, or sub-varieties, but that all these methods had been in vogue from early historic times. Even the simple act of bracing or stringing the bow varies quite as profoundly with different races.

The simplest form of release is that which children the world over naturally adopt in first using the bow and arrow, and that is grasping the arrow between the end of the straightened thumb and the first and second joints of the bent forefinger. I say naturally, because I have noticed that American as well as Indian and Japanese children invariably grasp the arrow in this way in the act of shooting. With a light or weak bow, such a release is the simplest

and best; and in this release it makes but little difference upon which side of the bow the arrow rests, provided the bow is held vertically. This release, however, prevents the drawing of a stiff bow unless one possesses enormous



Figs. 1 and 2. Primary release.

strength in the fingers. Figs. 1 and 2 illustrate this release. Arrows used in this release are usually knobbed at the nock, or proximal end of the arrow, for conven-

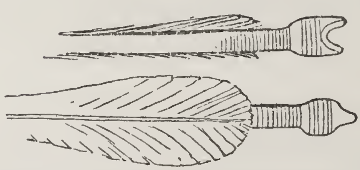


Fig. 3. Knobbed arrow from Oregon.

ience of holding; and an arrow of this form indicates a release of this or of a similar nature (Fig. 3).

The Ainos of Yezo practice this simple release. Their bow is short and highly strung when in use, and an arm-

guard is not required, as the recoil of the string, from the high tension of the bow, is arrested before striking the arm. Some of the old English archers also avoided the use of the arm-guard by using highly strung bows.

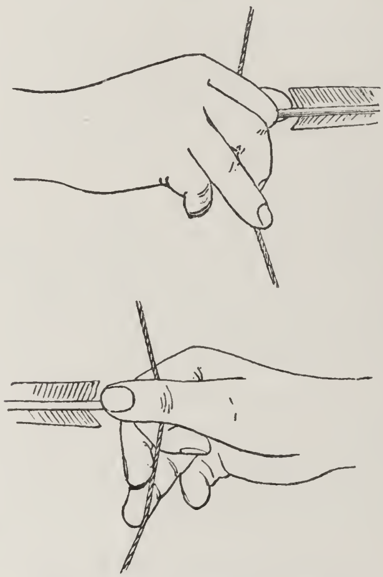
It is recorded that the Demerara Indians of South America practice this form of release; and from a photograph of a Ute Indian in my possession I should infer that that tribe also practiced this release. Col. James Stevenson informs me that when the Navajos shoot at prairie dogs they use this release, so that the arrow will not penetrate the ground if it misses its mark; and Mr. Daniel S. Hastings informs me that the Chippewa Indians sometimes practice this release.

I am indebted to Dr. S. J. Mixter for a photograph which he made for me, of an old Micmac Indian in the act of releasing the arrow in the primary way. The man is one of the oldest Micmacs in the Cascapedia settlement on the north shore of the Bay of Chaleur and he informed Dr. Mixter that he often used the bow when a boy, and practiced the release as represented. He also said that the other tribes in that part of Canada in the use of the bow drew the arrow in the same way. A member of the Penobscot tribe at Moosehead Lake gave me the primary release as that practiced by the tribe, and seemed incredulous when I told him that there were other methods of drawing the arrow.

This primitive method of releasing the arrow I shall designate as the *Primary release.*

The next form of release to be considered is one which is a direct outgrowth from the primary release. This release consists in grasping the arrow with the straightened thumb and bent forefinger, while the ends of the second and third fingers are brought to bear on the string to as-

sist in drawing. Figs. 4 and 5 illustrate the attitude of the hand in this release. Mr. Paul Mamegowena, an Ottawa Indian, informs me that his tribe practice this release, and he illustrated the method to me. Through the courtesy of Mr. Frank Hamilton Cushing I was enabled to make inquiries of a number of Zuñi chiefs in regard to their



Figs. 4 and 5. Secondary release.

method, and the release practiced by them differed in no respect from that of the Ottawas.

Mr. Daniel S. Hastings, formerly civil engineer on the Northern Pacific Railroad writes to me as follows regarding the Chippewa Indians of northern Wisconsin: "I have watched the Indians so as to find out their manner of drawing back the bow-string and releasing the arrow, and I find they all agree in one respect: they all grasp the arrow

between the thumb and forefinger. Some of them use the thumb and forefinger alone, while others use the second, and still others add the second and third fingers to assist in pulling the string back, and let the string slip off the ends of the second and third fingers at the same instant the arrow is released from between the thumb and forefinger." This release, though clearly distinct from the primary release, is an advance upon it in the added assistance of one or two fingers in pulling back the string; and the description given by Mr. Hastings is confirmatory of the natural relations existing between the two releases. For this reason it will be designated as the *Secondary release.*

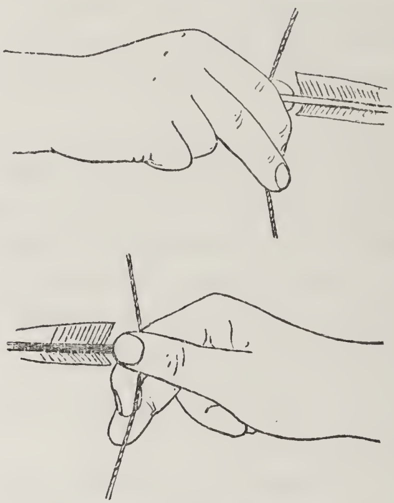
Mr. La Flesche, an intelligent Omaha, showed me a release practiced by his people which differs sufficiently from the secondary release to warrant its recognition as a separate form. In this release the forefinger, instead of being bent, is nearly straight with its tip, as well as the tips of the second and third fingers, pressing or pulling on the string, the thumb, as in the primary and secondary release, active in assisting in pinching the arrow and pulling it back. This release I shall call the *Tertiary release.* (See Figs. 6 and 7.)

Lieut. A. W. Vogdes, U. S. A., has informed me that the Sioux, Arapahoes, and Cheyenne practice the tertiary release; and Col. James Stephenson has noticed this release practiced not only by the two latter tribes but by the Assiniboins, Comanches, Crows, Blackfeet, and Navajos. Mr. La Flesche and Lieut. Vogdes informed me that the tribes using this release held the bow nearly horizontally.

In holding the bow horizontally the release-hand is held with the palm uppermost, the arrow, of course, resting on the bow. In the Zuñi and Ottawa practice, the bow

being held vertically or nearly so, the arrow is placed at the left of the bow. It is possible that originally the bow was held horizontally, but necessities arising, as in shooting in a forest, or shooting side by side with others closely appressed, the bow was required to be held vertically. In thus turning the bow-hand in the only way it could be turned conveniently, the arrow would be brought to the left of the bow vertical.

As will be shown further on, the position of the arrow



Figs. 6 and 7. Tertiary release.

either to the right or to the left of the bow vertical is determined in most cases by the method of release.

In the primary and secondary releases, however, it makes but little difference on which side the arrow is placed; and some tribes, using the bow vertical, place the arrow to the right, and this is probably a quicker way of adjusting the arrow when shooting rapidly. Col. James Stevenson informs me that Navajo Indians practice three methods of release, namely, the primary release already

alluded to, the tertiary release, and a variety of the Mediteranean release, which will be described further on.

During the recent visit of the Siamese embassy to this country, I obtained from its members through the courtesy of Mr. Wilberforce Wyke, interpreter, some interesting facts concerning the use of the bow in Siam. It was curious to find that the Siamese practiced the tertiary release; with this difference, however, that one finger only is used on the string instead of two. Mr. Nai Tuan illustrated the method to me, and explained that little use was made of the bow and arrow, its practice being confined to the shooting of small birds and fishes.

Major Snayh of the embassy told me that poisoned arrows were also used, in which case the bow was held horizontally, and the bow-hand grasped not only the bow, but a grooved board in which the arrow rested. In the last century, it was customary for the Turkish archer to use a grooved piece of horn which was held in the bow-hand directed towards the string. In this grooved piece the arrow ran, and by this contrivance the bow could be drawn much further back, even to the extent of bringing the head of the arrow four or five inches within the bow. According to Wilkinson, the ancient Egyptians were familiar with this curious adjunct to the bow.

E. H. Man, Esq., in his work on the Andaman Islanders,[1] p. 141, says that the inhabitants of Great Andaman "place the arrow in position between the thumb and top joint of the forefinger, and draw the string to the mouth with the middle and third finger." As Mr. Man in this description does not speak of the forefinger as bent and

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[1] On the Aboriginal Inhabitants of the Andaman Islands. By Edward Horace Man. Reprinted from the Journal of the Anthropological Institute of Great Britain and Ireland.

pressed against the arrow, the release practiced by these people must be the tertiary release.

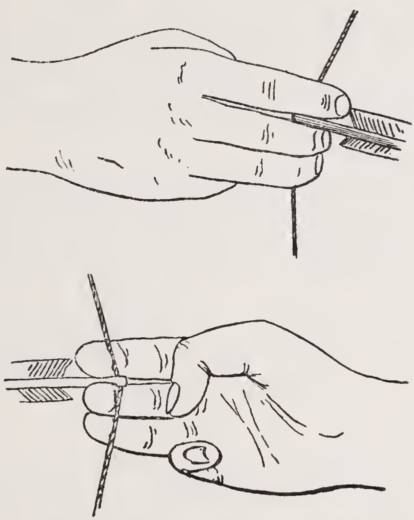
We have thus far considered three methods of release, of which the thumb and bent forefinger appressed forms the simplest and probably one of the earliest forms; and this we have called the primary release. The secondary release differs only in the application of the tips of the second finger, or second and third fingers, to the string, and must be regarded as a development of the primary release, though forming a distinct method. The third release differs in the position of the forefinger, which, instead of being bent and pressed against the arrow, is nearly straight, its tip, as well as the tips of the second and sometimes that of the third finger, engaging the string. This constitutes the tertiary release.

We come now to consider a release which by documentary evidence has been in vogue among the northern Mediterranean nations for centuries, and among the southern Mediterranean nations for tens of centuries. It is the oldest release of which we have any knowledge. It is practiced to-day by all modern English, French, and American archers, and is the release practiced by European archers of the Middle Ages. This release consists in drawing the string back with the tips of the first, second, and third fingers, the balls of the fingers clinging to the string, with the terminal joints of the fingers slightly flexed. The arrow is lightly held between the first and second fingers, the thumb straight and inactive.

Since this release has been practiced by the Mediterranean nations from early historic times, it may with propriety be called the *Mediterranean release*. The following figures (Figs. 8 and 9) illustrate this form of release.

In the practice of this release, the attrition of the string on the fingers is so severe that a leather glove or leather

finger-tips are worn, though some archers are enabled by long service to shoot with their fingers unprotected. Roger Ascham, in his "Toxophilus," written in 1544, says: "A shootinge glove is chieflye for to save a man's fingers from hurtinge, that he may be able to beare the sharpe stringe to the uttermoste of his strengthe. And when a man shooteth, the might of his shoote lyeth on the foremost finger, and on the ringman; for the middle



Figs. 8 and 9. Mediterranean release.

finger which is longest, like a lubber, starteth back, and beareth no weight of the stringe in a manner at all; therefore the two fingers must have thicker leather, and that must have thickest of all whereon a man lowseth most, and for sure lowsinge the foremost finger is most apt, because it holdeth best, and for that purpose nature hath, as a man would say, yocked it with the thoumbe."

Hansard, in his "Book of Archery," states that the Flemings use the first and second fingers only, a method adopted by some English bowmen. This Fleming variety of the

Mediterranean release, as we shall soon see, was probably the usual form in the Middle Ages. Among the many curious matters of interest concerning archery, which may be found in Hansard's book, is the description of a quaint black-letter volume which the author dug out in the Royal Library of Paris. This volume was written at the close of the thirteenth or beginning of the fourteenth century. It is entitled "The Book of King Modus," and is a treatise on the use of the bow in hunting. Among other matters is a chapter of "Instructions in the Art of Archery;" and in regard to the release, it says that "you draw the arrow with three fingers, holding the nock between the forefinger and the next thereto."

Associated with this release is the necessity of placing the arrow on the left of the bow held vertically. This position is necessitated by the fact, that as the string is pulled back the friction of the fingers which clutch the arrow tends to swing the arrow to the right; at the same time the friction of the fingers on the string causes the string to rotate somewhat to the right, and this tends to displace the arrow.

In a release of this nature, the arrow must be to the left of the bow vertical; and carved figures, manuscript drawings, and sculpture, in which the arrow is represented otherwise in connection with the Mediterranean release, must be incorrect. This release is unquestionably an advance on the others thus far described, as it enables the drawing of a stiffer bow, and is exceedingly delicate and smooth at the instant of loosing the arrow.

Mr. John Murdock, who accompanied the United States Signal Survey Expedition to the northwest coast of Alaska, has kindly furnished me the information that the Eskimo of Point Barrow practice the Mediterranean release, using, however, only the first and second fingers in drawing the string. I am also indebted to Mr. Mur-

dock for calling my attention to two other references concerning the practice of archery among these Arctic people.

Mr. Ludwig Kumlien, naturalist of the Howgate Polar Expedition, says of the Cumberland Sound Eskimo, "In shooting this weapon the string is placed on the first joint of the first and middle fingers of the right hand."[1]

The Krause brothers state that the natives of East Cape, Siberia, do not hold the arrow between the thumb and first finger, but between the first and middle fingers.[2]

Neither of these descriptions is complete, and yet both indicate unmistakably the Mediterranean release. It was somewhat surprising to find this release among the tribes of Eskimo, for I had supposed that the arrow-release of this people would be either in the form of the primary or secondary release. As a confirmation of this unlooked-for method of shooting among the west-coast

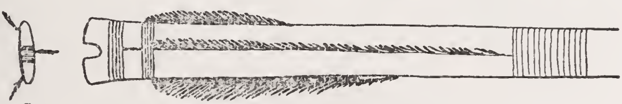
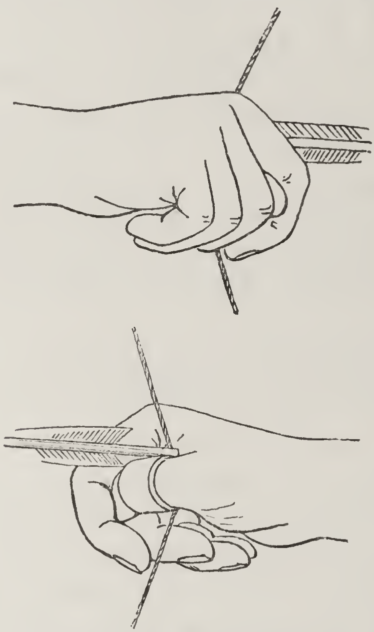


Fig. 10. Point Barrow Eskimo arrow, half size. *a*, end view.

Eskimo at least, Mr. Murdock called my attention to the shape of the nock end of their arrow, which was greatly flattened at right angles to the nock, so that it offered greater convenience for grasping between the fingers. It is possible also that this peculiar flattening may have something to do with the flight of the arrow. This flattening of the arrow I have never observed before; and an arrow of this shape must indicate unmistakably the method of release employed, for in no other form of release with which I am familiar could the arrow be discharged. Fig. 10 gives the appearance of this arrow.

[1] Bulletin of the U. S. National Museum, No. 15, p. 37.
[2] Deutsche geographische Blätter, Vol. I, p. 33.

If Mr. Man's information be correct, then the tribes inhabiting the Little Andaman practice the Mediterranean release. In his work on the Andaman Islanders before alluded to, the author says (p. 141) that the Jär'awa, or the tribes which inhabit the Little Andaman and southern portions of the Great Andaman, "adopt the plan usual among ourselves of holding the nock of the arrow inside the string by means of the middle joints of the fore and



Figs. 11 and 12. Mongolian release.

middle fingers, and drawing the string with the same joints."

While the four releases thus far described may be considered successive modifications of each other, though I do not mean to imply that they are so necessarily, the release which we are about to examine is an entirely independent form, having no relation to the others. In this release the string is drawn by the flexed thumb bent over

the string, the end of the forefinger assisting in holding the thumb in this position. Figs. 11 and 12 illustrate this release. The arrow is held at the junction of the thumb and forefinger, the base of the finger pressing the arrow against the bow. For this reason the arrow is always placed to the right of the bow vertical.

This release is characteristic of the Asiatic races, such as the Manchu, Chinese, Korean, Japanese, Turk, and doubtless other cognate peoples. The Persians also practice this release, which they probably acquired from their proximity to, and association (friendly and otherwise) with, Asiatic people of past times.

As this release is practiced almost exclusively by Mongolian nations, it may be called the *Mongolian release*.

In this release the thumb is protected by a guard of some kind. With the Manchu, Chinese, and Turk, as well as with the Persian, this guard consists of a thick ring, which is worn near the base of the thumb. The thick edge of the ring is brought to bear upon the string as it is drawn back, and at the same time the string is quickly released by straightening the thumb. The ring may be made of any hard material, such as horn, bone, ivory, quartz, agate, or jade. These rings are often very expensive. I was shown one in Canton that was valued at three hundred dollars. Fig. 13 illustrates an ordinary horn ring such as the Cantonese use.

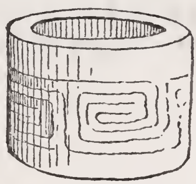


Fig. 13.
Chinese thumb-ring.

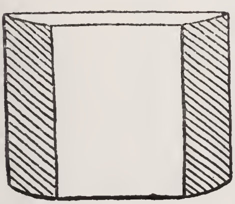


Fig. 14.
Chinese thumb-ring of jade, in section.

Fig. 14 shows a Chinese thumb-ring in section, made of jade. This ring, being used with bows having thicker strings, is correspondingly larger. The Korean thumb-ring is quite unlike that used by the Chinese, as will be seen

by Fig. 15. The ring is thin, and from its shape is evidently used to protect the ball of the thumb. The string is not engaged by the edge of the ring, as in the Chinese

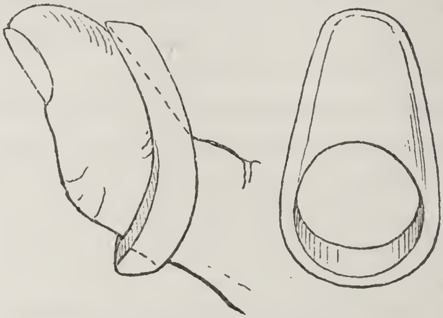


Fig. 15. Korean thumb-ring.

method, but rests upon the side of the ring.[1] The Japanese archer, instead of using a thumb-ring, is provided with a

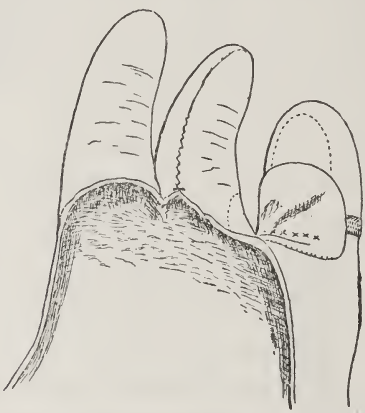


Fig. 16. Japanese archer's glove (portion only shown).

glove consisting of thumb and two fingers. The wrist of the glove is firmly bound to the wrist by a long band,

[1] I was told by a Korean ambassador in Tokio, that in archery the Koreans are taught to draw the arrow with either hand, but considered the left hand most efficient. In illustrating the method of release he drew the arrow with his left hand. The bow is firmly grasped, and an arm-guard is worn.

which is fastened to one flap, passes through a hole in the opposite flap, thus enabling it to be pulled up like a noose, and then is wound tightly about the wrist several times. The thumb of the glove is much thickened, and is very hard and stiff (Fig. 16). Its operation is like that of the Korean thumb-ring.

In the Korean and Japanese practice the first and second fingers assist in holding the thumb bent on the string, while in the Manchu release only the first finger is so

Fig. 17. Manchu.

used, the other three fingers being inactive and closed. There are doubtless other modifications of this release ; the essential features however remain the same.

A young Japanese from the north of Japan, in illustrating to me his method of release, drew the string back with the thumb and interlocked forefinger as already described, and assisted the drawing back of the string with the tips of the second and third fingers, as shown in the *secondary release.*

The accompanying figure illustrates the attitude of the shaft hand of a Manchu as seen from above, which I sketched from a Manchu soldier at Canton. (Fig. 17.) The

Persians and Turks use the thumb-ring in the same way. Fig. 18, representing the Persian thumb-ring, is copied from a drawing given in Meyrick's "Ancient Armour." Hansard, referring to another author, says that "one of the early Turkish Sultans occupied his leisure in manufacturing these rings," distributing them as presents among his favorite pashas; and adds also that the carnelian thumb-rings may be easily procured in the Bazäars of Constantinople.

Some notes in regard to Persian archery may be found in "Hansard's Book of Archery," p. 136.

The "Archers' Register" published a number of notes from a manuscript copy of "Anecdotes of Turkish Archery procured from Constantinople by Sir Robert Ainslie, and translated by his interpreter, at the request of Sir Joseph Banks, Baronet, 1797," from which we quote:—

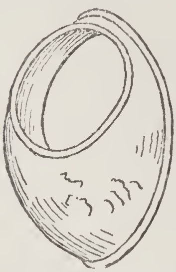


Fig. 18.
Persian thumb-ring.

"The bow, instead of being drawn with three fingers on the string, according to our mode, was drawn by the right thumb, with the arrow placed on the string immediately above it. A thumb-piece, or guard of bone, answering the purpose of our 'tips,' was worn. It covered the ball of the thumb, one end being made as a ring and passed over the joint. A projecting tongue in the inside prevented the string slipping off the guard into the angle of the thumb formed by the bent joint. The inside of the guard was lined with leather. A curious contrivance, consisting of a horn-groove several inches in length, fixed on a foundation of wood attached to a leather strap and buckle, was fastened on the bow-hand. The groove projected inwards. The arrow was laid in this groove, which rested on the thumb, and was rather higher on the outside, as the arrow was shot on the right side of the bow, on the contrary side to what it is in England."

There are doubtless other forms of release, but those already given probably comprise the principal and most efficient ones.

At Singapore I was enabled to secure, through the kindness of D. F. A. Hervey, Esq., of Malacca, a Malay release of the Temiang tribe, originally from Sumatra. The bow was held in an horizontal position (a hole being made in the centre of the bow through which the arrow passed), the three fingers bent over the string, and the arrow held between the first and second fingers, the thumb straight-

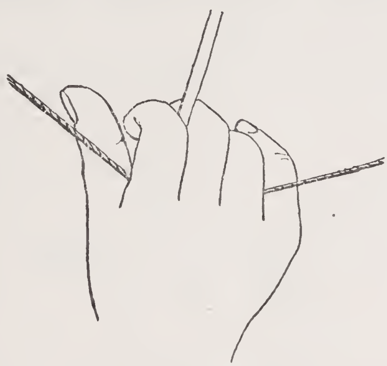


Fig. 19. Temiang release.

ened, and the little finger partially straightened and bearing against the string as in the figure (Fig. 19). This was a weak release, and was used only in the shooting of small game and fish. An entirely different form of release is used by this people in shooting fire at the spirit of sickness. The bow is perforated as in the bow above mentioned; the arrow has a shoulder near the distal end which prevents it passing through the hole, and the nock is fastened to the string. A ball of inflammable material is loosely placed on the end of the arrow, and when the arrow is released it is suddenly checked by its shoulder striking

the bow and the fire-ball is projected into the air by its momentum. The release in this act is shown in Fig. 20.

The first finger passes above the string and under the arrow, the thumb being straightened and the arrow grasped between the thumb and finger. This is a most awkward and inefficient release; and as the descriptions of this and the previous Malay release were given me by an old man, who was at the time being questioned by Mr. Hervey in the interest of philology, it is possible that the releases may have been incorrectly described.

The releases thus far given comprise those forms which have been studied from life.

It now remains for us to examine the releases of ancient

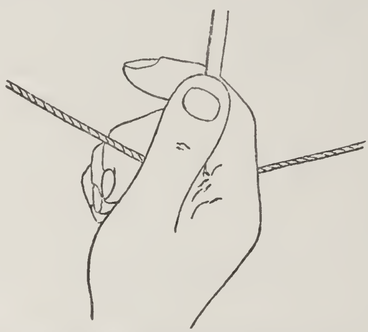


Fig. 20. Temiang release when shooting at spirit of sickness.

peoples which are made known to us through illuminated manuscripts, frescos, rock sculpture, and other graphic methods. From the conventional way in which many of these are depicted, great difficulty is encountered in properly interpreting the exact method of release intended. In many cases, especially in certain forms of the ancient Egyptian, as shown in the frescos, and early Grecian, as represented on their decorative vases, it is well nigh impossible to recognize any mode in which the arrow could be drawn. In some cases the release might be intended

to represent either of two or three kinds. That many releases are represented incorrectly there can be no doubt. In figures of Egyptian archers, the hand is depicted as daintily pulling the arrow in a way that could not possibly accomplish the drawing of a stiff bow; and that the Egyptian archer used a stiff bow is seen in the vigorous manner in which he is represented as bracing it with knee pressed against its middle, while tying the cord above.

It will be best, however, to give a description of those releases that can be clearly interpreted, beginning with the Assyrian. I had a brief opportunity of studying the wonderful collection of Assyrian slabs at the British Museum, and also the Assyrian collections at the Louvre. In the various scenes of war and hunting so graphically depicted, the most perfect representations of archers in the act of drawing the bow are given.

At the outset I met with a very curious and unaccountable discrepancy in the form of release employed, and that was when the archer was represented with his right side, or shaft hand, toward the observer, the hand was with few exceptions in the attitude of the primary or secondary release; whereas if the archer was represented with his left side, or bow hand, toward the observer, the release with few exceptions represented the Mediterranean release. Or, in other words, as one faces the sculptured slab the archers, who are represented as shooting towards the right, show with few exceptions either the primary or secondary release, while those shooting towards the left are with few exceptions practicing the Mediterranean release!

If in every case the Assyrians were represented on the left, as one faces the tablet, fighting the enemy on the right, then one might assume that the enemy was practicing a different release. In an Egyptian fresco, for ex-

ample, where Rameses II. is depicted in his chariot fighting the Arabs, the enemy is represented as practicing a different release. While in many cases the Assyrians are on the left of the picture, in other cases they are on the right, and shooting towards the left. It is therefore difficult to decide which release was practiced by them; and all the more so, since, with very few exceptions, the releases are perfect representations of forms practiced today, which have already been described. I have suspected that in one or two cases the Mongolian release might have been intended, though in no case is the thumb-ring represented, though other details of arm-guards, bracelets, etc., are shown with great minuteness.

Taking the releases as they are represented in the sculpt-

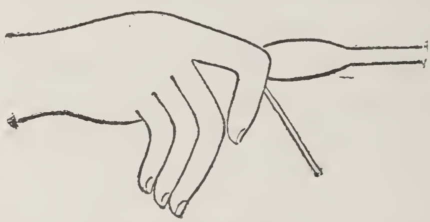


Fig. 21. Assyrian.

ures without regard to the discrepancies above noted, it is an extremely interesting fact that all the earlier Assyrian archers, that is, of the time of Assurnazirpal, or 884 B. C., the release represented is the primary one, as shown in Fig. 21; while in the archers of the reign of Assurbarnipal, or 650 B. C., the secondary release is shown, or a variety of it, in which the tips of all three fingers are on the string, as shown in Fig. 22. Between these two epochs the sculptures ranging from 745–705 B. C., notably a slab representing the campaign of Sennacherib showing assault on the Kouyunjik Palace, both the primary and secondary releases are represented. If any reliance can

be placed on the accuracy of these figures, an interesting relation is shown in the development of the secondary from the primary release, as urged in the first part of this paper. Possibly a proof that the primary release is in-

Fig. 22. Assyrian.

tended is shown in the fact that the arrows are represented with the nock end bulbous.

On tablets in the British Museum of this intermediate age, or during the reign of Tiglath Pileser, is the first representation of an archer with the right side towards the

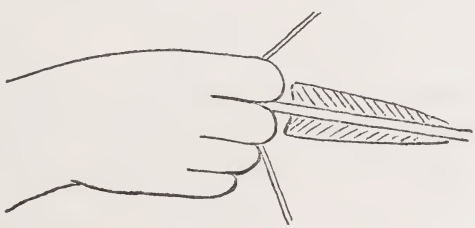


Fig. 23. Assyrian.

observer practicing the Mediterranean release; and on slabs of the date of 650 B. C., one showing Assurbarnipal's second war against Elam, and another one representing the siege of the city of Al-ammu, a number of archers with their right towards the observer are practicing the Mediterranean release (Fig. 23). In the Mediterranean release, which, as I have before remarked, is represented,

with few exceptions, by all the archers having the bow-hand towards the observer, there are two varieties shown; one in which three fingers are on the string, and another

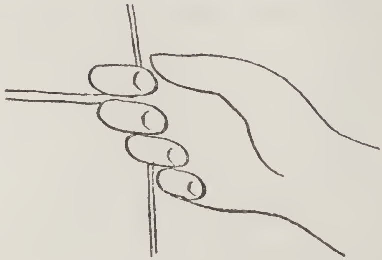


Fig. 24. Assyrian.

with only two fingers drawing the bow, as shown in the accompanying figures (Figs. 24, 25). The Mediterranean release occurs in Assyrian sculpture as early as 884

Fig. 25. Assyrian.

B. C., as shown on a marble slab in the British Museum representing the siege of a city by Assurnazirpal (Fig. 26). A curious form is shown in Fig. 27, showing Assur-

Fig. 26. Assyrian.

barnipal in a chariot, shooting lions. The string below is concealed by the archer's arm. The secondary release is probably intended.

In regard to the bow-hand, the thumb is sometimes represented as straight and guiding the arrow, and in other cases as braced inside of the bow. In this connection it may be interesting to note that in the earliest Assyrian bows the ends of the bows are straight and blunt, the nocks being a simple groove and the string being tied

Fig. 27. Assyrian.

whenever the bow is braced, as in certain modern Indian and Aino practice. Other bows are shown at this period with a nock somewhat oblique, and it is possible that the string might have been looped and slipped into the notch, as in the modern English bow.

In the later slabs, that is 650 B.C., the ends of the bow are shown abruptly bent, the bent portion in some cases

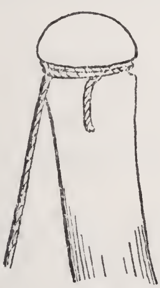


Fig. 28.

Fig. 29.

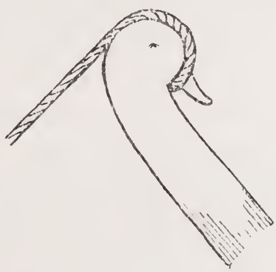


Fig. 30.

being carved to represent a bird's head. In the bracing of this bow the string has a permanent loop, and the assistance of a second person is required to slip this loop over the point of the nock while the archer is employed in bending the bow, which is done by drawing the ends of the bow towards him, the knee at the same time being pressed in the middle of the bow. (Figs. 28, 29, 30.) In

the earlier reign, the arrows are shown with larger nocks and the barbs, long and narrow, with their outer edges generally parallel to the shaft. The nock end of the arrow is bulbous, as before remarked; and if this is correctly represented it would settle the question as to the primary release being the one intended. In the later slabs, the arrow has shorter barbs, with the feathers tapering forward towards the point, and the nock end of the arrow is not bulbous.

A more careful study than I was able to give to these sculptures may probably modify the general statements here made concerning the variations in time of the bow and arrow.

Concerning the practice of archery among the ancient Egyptians, Wilkinson in his classical work mentions only two forms of release. He says their mode of drawing the bow was either with the thumb and forefinger or with the first and second fingers.[1] Rawlinson makes the same statement.[2] These two forms as defined by these authors would be the primary and Mediterranean releases.

If the representations of the drawings and frescos in ancient Egyptian tombs, as given by Rosallini, Lepsius, and others, are to be relied on, then the ancient Egyptians practiced at least three, and possibly four, definite and distinct methods of release.

That many of the releases depicted in these old sculptures and frescos are conventional simply, there can be no doubt; indeed, some of the releases are plainly impossible, notably that form which shows the archer daintily drawing back a stiff bow with the extreme tips of the first two fingers and thumb. Again, the figure of Rameses II. (see

[1] Manners and Customs of the Ancient Egyptians, 2nd series, Vol. I., p. 207.
[2] History of Ancient Egypt, Vol. I., p. 474.

Wilkinson, Vol. I., p. 307), which shows the bow vertical while the shaft-hand is inverted, that is, with palm uppermost, is an equally impossible attitude. Other releases identify themselves clearly with forms already described, and with slight latitude in the interpretation of the conventional forms we may identify these as belonging to known types.

The earliest releases are those depicted on the tombs of Beni Hassan of the time of Usurtasen I., which according

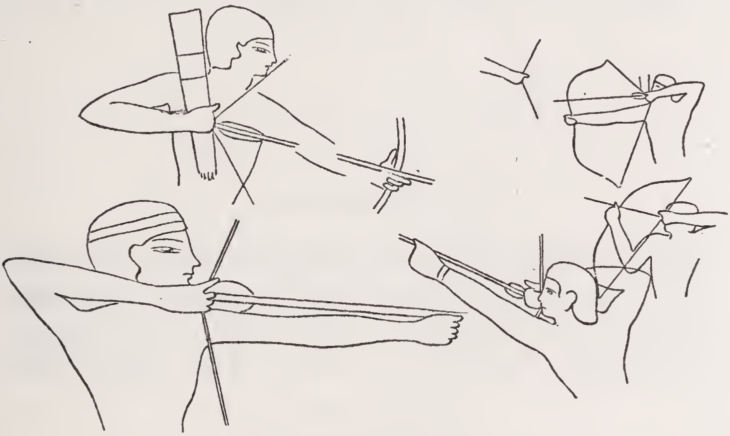


Fig. 31. Early Egyptian.

to the conservative chronology of Professor Lepsius dates 2380 B.C. Here the Mediterranean release is unmistakably shown. The following figure (Fig. 31) from these tombs, copied from Rosallini's great work, indicates this form of release in the clearest manner. In these figures it is interesting to observe that the arrow is drawn to the ear, and also that the archers are represented as shooting with the left as well as with the right hand.

Making a stride of over a thousand years and coming down to the time of Seti I. (1259 B.C.), we have represented a release as well as a mode of drawing the arrow above and

behind the ear, which recalls in the action of the arm certain forms of the Mongolian release. (Fig. 32.) It is true the attitude of the hand might be interpreted as representing the thumb and bent forefinger as shown in the

Fig. 32. Egyptian. Seti I.

primary release, but the free and vigorous drawing of the bow as shown in the figure could not possibly be accomplished in the primary form with a bow of any strength. Furthermore, the attitude assumed by the Manchu and

Fig. 33. Egyptian. Rameses II.

Japanese archer in the Mongolian release vividly recalls this picture of Seti. Egyptologists state that Seti I. was occupied early in his reign with wars in the east and in resisting the incursions of Asiatic tribes; and we venture to

offer the suggestion that during these wars he might have acquired the more vigorous release as practiced by the Asiatics.[1] Whatever may be the method depicted in the drawing of Seti, it is quite unlike the releases of the time of Usurtasen, and equally unlike the figures of Rameses II., which are so often portrayed.

In Figs. 33, 34, copied from Rosallini, the thumb and the forefinger partially bent may be intended to represent the primary release, as in no other way could be interpreted the bent forefinger and straightened thumb holding

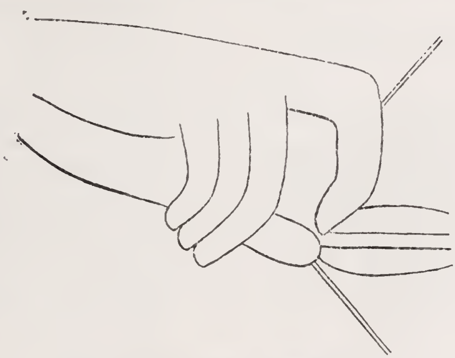


Fig. 34. Egyptian. Rameses II.

the tip of the arrow, with three other fingers free from the string.

In the British Museum are casts of a hunting scene, and also of battle scenes of the time of Rameses II., in which the shaft-hand of the archer is in an inverted position. This form of release associated with a vertical bow is an impossible one. Either the hand is wrongly drawn, or the attitude of the bow is incorrectly given. The only explanation of this discrepancy is the assumption that the bow was

[1] It would be extremely interesting to know whether any object answering the purpose of a thumb-ring has ever been found among the relics of ancient Egypt.

really held in an horizontal position, and the release practiced was the one I have designated as the tertiary release. The Egyptian artist, ignorant of perspective drawing and utterly unable to represent a bow foreshortened, has drawn the bow in a vertical position. As a further proof of this, we find that the tribes of North American Indians and the Siamese who practice the tertiary release usually hold the bow in an horizontal position. An examination of the accompanying figures will make this clear. Fig. 35 is copied from the cast referred to in the British Museum; Fig. 36, from Wilkinson, Vol. I., p. 307; Fig. 37, from Wilkinson, Vol. I., p. 309. Reginald Stuart Poole, Esq., of the British Museum, has kindly sent me an outline of the nock end of the ancient Egyptian arrow which shows a straight and

Fig. 35. Egyptian.

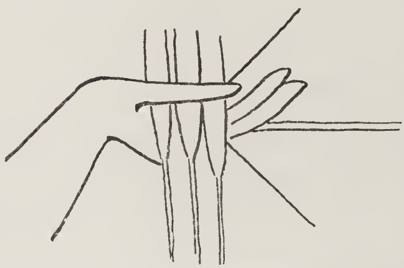


Fig. 36. Egyptian.

Fig. 37. Egyptian.

cylindrical shaft. Figs. 38, 39, 40, and 41 are copied from Rosallini. Fig. 38 is probably intended for the primary, Fig. 39 the tertiary probably, and Figs. 40 and 41 the Mediterranean form.

Turning now to the practice of archery among the ancient Grecians, we should expect to find among these peo-

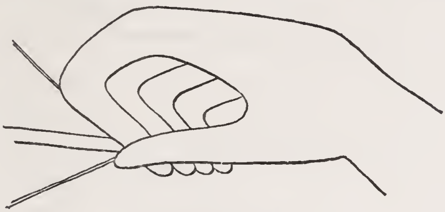


Fig. 38. Egyptian.

ple, at least, the most distinct and truthful delineations of the attitude of the hand in shooting. Hansard, in his "Book of Archery," p. 428, says of the ancient Greek archers, "Like the modern Turks, Persians, Tartars, and many other Orientals, they drew the bow-string with their thumb, the arrow being retained in place by the forefinger. Many

Fig. 39. Egyptian.

sculptures extant in public and private collections, especially those splendid casts from the Island of Egina now in the British Philosophical and Literary Institution, represent several archers drawing the bow-string as I have described."

A study of a number of ancient Grecian releases as shown in rock sculpture and on decorated vases reveals only one release that might possibly be intended to represent the Mongolian method, and this is shown on a Greek

vase (black figures on red) figured in *Auserlesene Vaserbilder*. With this exception the releases thus far examined are as various, and many of them quite as enigmatical, as those seen among the ancient Egyptians. I puzzled for a long time over these sculptures from the temple of

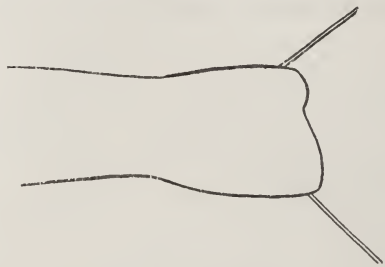


Fig. 40. Egyptian.

Athena to which Mr. Hansard refers, and was forced to come to the conclusion that, despite their acknowledged accuracy, the release was an impossible one. It was not till sometime after that I learned that the figures had been carefully restored by Thovaldsen, and the restored parts com-

Fig. 41. Egyptian.

prised the hands and arms, as well as the extremities of most of the figures. With this information I had occasion to hunt up a history of these figures, and found the following in a work by Eugene Plon entitled "Thovaldsen his Life and Works," republished in this country by Roberts Brothers. The figures were restored by Thovaldsen in 1816. Among the restored parts were the hands of the archers. "The statues were in Parian marble, and he used so much

care in matching the tints of the new pieces as almost to deceive a practiced eye. He was frequently asked by visitors to the Atelier which were the restored parts. 'I cannot say,' he would reply laughing; 'I neglected to mark them, and I no longer remember. Find them out for yourself if you can' " (p. 56). Of these restorations, however, it is possible that Mr. Hansard was not aware, though if he had ever attempted drawing a bow in the manner represented in these figures, he would have seen the absurdity as well as the impossibility of the attitude; and, furthermore, had he been at all familiar with the Mongolian release he would have seen that there was really no approach to the form as employed by the Manchu, Korean, Japanese, or Turk. The following figure (Fig. 42) is sketched from the set of casts in the Museum of Fine Arts in Boston. An examination of these

Fig. 42. Thovaldsen's restoration of hand.

figures will show that the angle made by the shaft-hand in relation to the bow-hand is also inaccurate. A release that might at first sight suggest the Mongolian form is shown in the accompanying figure (Fig. 43) representing an Amazon archer, which is painted on a Greek vase of the 4th century B.C. The forefinger seems to be holding the end of the thumb, but the thumb is not hooked over the string as it ought to be. If the hand be correctly drawn it represents quite well the tertiary release; and this supposition is borne out by two sculptures, one from the Temple of Apollo Epicurius at Phigalia (Fig. 44), and another from

Lycia, Asia Minor. (Fig. 45.) In these two examples the hand seems to be in the attitude of drawing the bow, with the fingers partially bent on the string, and the thumb

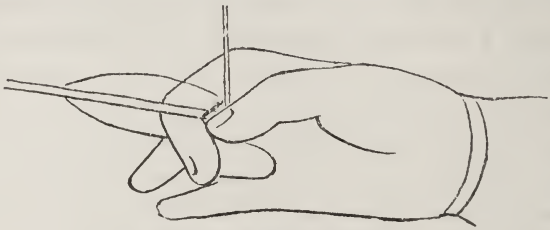


Fig. 43. Amazon archer.

assisting in holding the arrow; and this is the form of the tertiary release.

The earliest Greek release that I have seen is represented

Fig. 44. Phigalia.

on a block of stone sent to this country by the Assos Exhibition, and now the property of the Boston Museum of Fine Arts. It is supposed to date about 2200 B. C.

Fig. 45. Lycia, Asia Minor.

In this figure the hand is vigorously grasping the string, with the first and second fingers abruptly bent, the third and fourth fingers apparently having been broken away. (Fig. 46.)

If this release really represent a permanent form of shooting, then this form should have been designated the primary release; but, so far as I have learned, it seems to be a temporary mode resorted to only under special conditions. In testing the stiffness of a bow, for example, the string is grasped in this manner. An instance of this is seen on one of the Assyrian slabs, where the king is represented as trying a bow. I was informed by a Zuñi chief that when shooting in a great hurry the string was vigorously clutched by three or four fingers, the arrow being held against the first finger by the thumb.

The Ainos on the west coast of Yezo also informed me

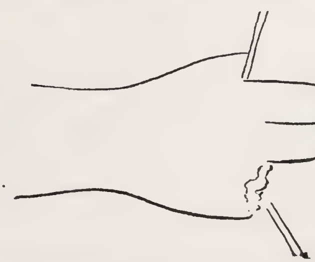


Fig. 46. Assos.

that when shooting in great haste the string was clutched in precisely this manner. In the use of a bow of any strength, the attrition of the string on the fingers must be very severe; and only a hand as tough, and as thoroughly calloused as the paw of an animal, could endure the friction of the string in such a release. For convenience of reference this form may be referred to provisionally as the *Archaic release*.

In a bas-relief in marble representing Herakles drawing a bow, a figure of which is given in Rayet's *Monuments de l'Art Antique*, it is rather curious that the hand is represented as clutching the string in the vigorous manner just described. The date of this work is put down as the fourth or fifth century B. C. Doubts have been expressed

as to the genuineness of this work. Dr. Alfred Emerson has expressed his belief in the "American Journal of Archæology," Vol. I., p. 153, that the work is a modern fraud. In the following number of the Journal Mr. Furtwängler defends the work, but would place it not earlier than the first century B. C. He says it is not ar-

Fig. 47. Grecian.

chaic, but archaistic. Whether the work be genuine or spurious I am not competent to judge. I may venture to say, however, that the attitude of the shaft-hand is very inaccurate. However absurd the drawing of the hand often is in these early Greek releases, the artists have rarely failed to adjust the arrow correctly in relation to

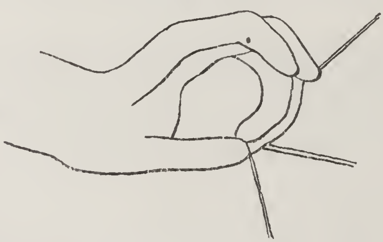


Fig. 48. Grecian.

the bend of the bow and the angle made by the string in tension. In this bas-relief of Herakles, however, the attitude of shooting is one of which no artist capable of making so robust and correct a body and pose would be guilty, and it certainly lends some weight to the supposition of Dr. Emerson as to the possible character of the work.

The accompanying figures are interesting as showing the conventional and even grotesque ways in which the arrow release is often represented on early Grecian vases. Figs. 47 and 48 are copied from *Weiner Vorlage Blätter*, Series D, Taf. IX, XII. Fig. 47 shows the hand reversed, with the thumb below instead of above. It is possible to shoot an arrow in this way but hardly probable that so awkward and unnatural an attitude would be taken. This release is intended to represent the tertiary release. Fig. 48 as drawn is an impossible release, though this release also may be intended to represent the tertiary release, the thumb being straight, and the arrow being held between

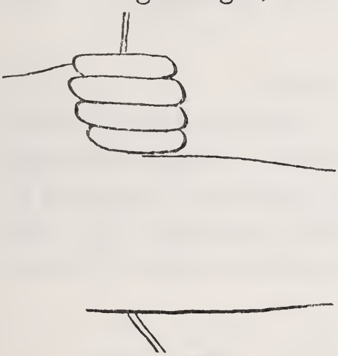


Fig. 49. Grecian.

Fig. 50. Grecian.

the thumb and forefinger, while the second finger, and in Fig. 48 the second, third, and fourth fingers are on the string.

In *Monuments Inedits.*, Vol. I., Plate LI., is figured the famous Chalcidian or Achilles vase, supposed to have been made in the early part of the sixth century B. C. Here the archer is shown left-handed. Assuming the drawing to be correct, the release represents the archaic form (Fig. 49).

Another release figured in the same volume, Plate XX., may be intended to represent the tertiary release (see Fig. 50). On Plate L., Vol. II., of the same work is fig-

ured a Grecian vase of the fourth century B. C., on which are depicted two releases which are probably the tertiary form (Fig 51). On Plate XVIII. of the same volume is figured an archaic Etruscan vase on which a curious de-

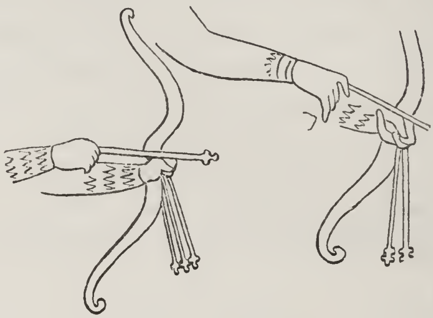


Fig. 51. Grecian.

lineation of an archer is given. The bow-hand is so well drawn that one is almost inclined to imagine that some mechanical device for releasing the arrow is intended by the curious representation of the shaft-hand (Fig. 52). Three other curious releases are shown in Figs. 53, 54 and

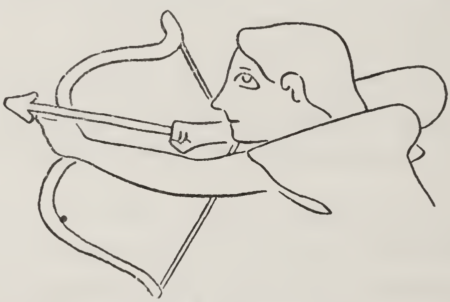


Fig. 52. Etruscan.

55, the latter copied from a Greek vase (black figures on red) supposed to be of the sixth century B. C. All these, though incorrectly represented, are probably intended for the tertiary release. Fig. 56 is copied from a figure given in *Auserlesene Vaserbilder*, representing a Greek vase of

the sixth century B. C. In this the archer's hand most certainly suggests the Mongolian release. It is true the thumb is not bent on the string, but it is bent with the second and presumably the first finger pressing against it.

Concerning ancient Persian releases, only two have fallen

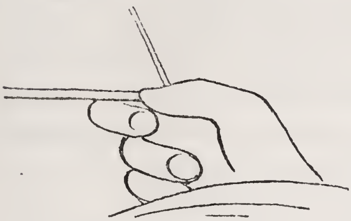


Fig. 53. Grecian.

Fig 54. Grecian (bas-relief).

under my notice. One is preserved on a silver cup of the Sassanid Dynasty, fifth century B. C. This is figured in *Monuments Inedits.*, Vol. III., Plate 51. In this figure the bow is a typical Manchu. The release is unquestionably a variety of the Mongolian release, the second and

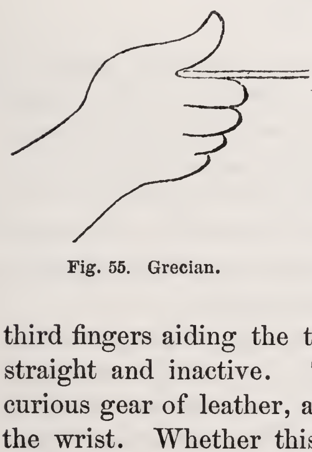


Fig. 55. Grecian.

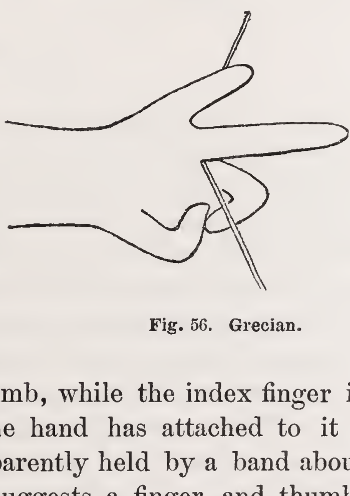


Fig. 56. Grecian.

third fingers aiding the thumb, while the index finger is straight and inactive. The hand has attached to it a curious gear of leather, apparently held by a band about the wrist. Whether this suggests a finger- and thumb-

guard similar to that used by the Japanese it is difficult to determine. (Fig. 57.)

In the Journal of the Royal Asiatic Society of Bengal, Vol. VII., Part I., p. 258, 1883, is a communication from Major General A. Cunningham, entitled "Relics from Ancient Persia in Gold, Silver, and Copper." These objects were found on the northern bank of the Oxus. Judging from the coins, the author regards the deposit as having been made not later than 180 or 200 years B. C. Among the relics was a stone cylinder, upon which were represented two Persian soldiers capturing two Scythians. The representations of the hands are too imperfect for one to judge with any precision of the character of the release in-

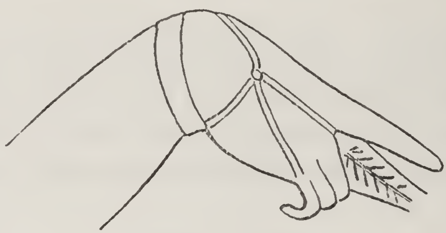


Fig. 57. Persian.

tended. The attitude of the hand in every case, however, suggests the Mongolian release. The bow is short, and of a form similar to the Manchu bow of to-day. It is interesting to notice that the Scythians are represented as shooting left-handed, and in this connection to recall the advice which Plato gives in regard to archery,—that both hands should be taught to draw the bow, adding that the Scythians draw the bow with either hand.

In regard to Chinese archery in ancient times, the classics of China abound in allusions to archery, and there can be no doubt that the release as practiced to-day is identical with the release practiced three thousand years

ago. The Analects of Confucius, the Doctrine of the Mean, and other ancient writings bear ample testimony to the high esteem in which this manly art was held.

In the Shi King, or book of ancient Chinese poetry (translation of Legge), the following allusions refer to the use of the thumb-ring, which was also called a thimble, and also a *pán chí*, or finger regulator.

"With archer's thimble at his girdle hung."

And again,—

"Each right thumb wore the metal guard."

Concerning Japanese archery methods in past times,

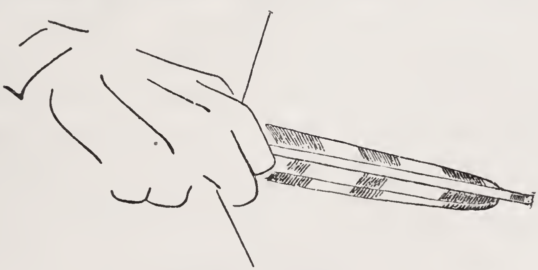


Fig. 58. Japanese.

what little evidence we have on the subject points to a Mongolian form of release. The archers have always formed a favorite study for the Japanese artist, and many details of the bow and arrow and attitudes of the archer may be got from old paintings and drawings. The representations of the hand in shooting, though often drawn conventionally, are easily interpreted as releasing the arrow after the Mongolian method. Fig. 58 is copied from a vigorous drawing, showing the attitude of the shaft-hand in the attitude of release. In the Shinto temple at Miyajima is a picture over two hundred years old, in which the archer's hand is shown in the attitude of the

Mongolian release. A picture of Tanniu, painted one hundred and fifty years ago and supposed to be a copy of a Chinese subject six or seven hundred years old, shows plainly the Mongolian release. In a picture by Keion, seven hundred years old, the archer is represented in the act of wetting with his tongue the tips of the first two fingers of his hand; and this certainly suggests the Japanese form of the Mongolian release.

Among the Emperor's treasures at Nara is a silver vessel supposed to be of the time of Tempei Jingo (765 A. D.), upon which is depicted a hunting-scene. Here the release, if correctly depicted, suggests the Mediterranean form. The bow is Mongoloid. The vessel is probably Persian: it is certainly not Japanese. The earliest allusions to Japanese archery are contained in "Kojiki, or Records of Ancient Matters," of which its translator, Mr. Basil Hall Chamberlain, says: "It is the earliest authentic literary product of that large division of the human race which has been variously denominated Turanian, Scythian, and Altäic, and even precedes by at least a century the most ancient extant literary compositions of non-Aryan India." These records take us back without question to the 7th century of our era. In this work allusion is made to the *heavenly feathered arrow*, to the *vegetable wax-tree bow* and *deer bow*, and also to the *elbow pad*. It is difficult to understand the purpose of the elbow pad in archery, assuming the same practice of the bow in ancient times as in present Japanese methods. It is difficult to believe that a pad on the elbow was needed to protect that part from the feeble impact of the string. If the pad was a sort of arm-guard surrounding the elbow, then one might surmise the use of a highly strung bow of Mongolian form held firmly and not permitted to rotate as in the Japanese style.

The peculiar twist given the bow by the Japanese archer is, so far as I know, unique in archery practice. In Siam, a bow of curious construction is used for throwing clay balls. The ball is held in a netting, the string of the bow is double, the bow-hand has the thumb braced vertically against the inside of the bow, so that it may not interfere with the flight of the ball. A peculiar twist is given the bow, so that the ball passes free from it.

I know of no record to show that the Japanese ever used a bow of this nature; in the Emperor's treasure-house at Nara, however, is preserved a curious bow nearly a thousand years old, and this is undoubtedly a bow used for throwing clay or stone balls. Instead of a netting to hold the ball there is a perforated leathern piece. This piece is adjusted to the cord a third way down the bow, at about the point from which the Japanese archer discharges the arrow. Whether the Japanese archer acquired this curious twirl of the bow to protect the feathers from rubbing against its side, or to escape the painful impact of the string, or, which is not improbable, acquired this novel twist from using the ball-throwing bow it is difficult to determine.

In regard to the release practiced by the various tribes in India, I have no information.

Through the courtesy of the lamented James Fergusson, I was permitted to examine his large collection of photographs of Indian Temples; and in a brief examination of these pictures I discovered a few releases in the sculptures. In the Peroor Temple near Coimbatore, an eight-armed God is represented as holding upright, between the first and second fingers of the right hand, an arrow. It is impossible to conjecture the form of release in this attitude; though, if the arrow were carried to the string in this position, the Mediterranean release would be suggested.

On the southwest face of the temple of Halabeed, Mysore, an archer is shown with the arrow already released; the attitude of the hand, however, suggests the Mediterranean form. In the Valconda, a small, ruined temple near Calamapoor, archers are shown having the tips of all the fingers on the string, in the same position as shown in the later Assyrian release; and this would indicate the secondary release.

These data are altogether too few and vague to determine the form or forms of release of these people.

Concerning ancient methods of archery in America, but little can be said. Probably the most reliable data are to be found in the few Mexican records which survived the shocking desecration by the Catholic Church at the time of the Conquest.[1]

An examination of the plates of Kingsborough's "Mexican Antiquities" reveals a number of hunters and warriors armed with bows and arrows. The figures at best are somewhat rudely drawn; those that are in action have the shaft-hand so poorly drawn that in most cases it is difficult to make out the release. In the few drawings in which the attitude of the shaft-hand is clearly shown, the tertiary release is probably indicated.

To Mrs. Zelia Nuttall Pinart I am indebted for tracings of archers from the *Atlas Duran*, Plate I., and *Mappe Quinatzin* I, Plate IV. These, though quite as ambiguous as those to be found in Kingsborough's, can only be interpreted as representing the tertiary release. In the latter

[1] The fiercely intolerant spirit of the representatives of the church is well illustrated by the language of a letter written by Zumarraga, the chief inquisitor of Mexico, to the Franciscan chapter at Tolosa, in January, 1531. The words are as follows: "Very reverend Father, be it known to you that we are very busy in the work of converting the heathen; of whom, by the grace of God, upwards of one million have been baptized at the hands of the brethren of the order of our Seraphic Father, Saint Francis; five hundred temples have been levelled to the ground, and more than twenty thousand figures of the devils they worshipped have been broken to pieces and burned."—*Examples of Iconoclasm by the Conquerors of Mexico*, by W. H. Holmes.

work, Plates 90 and 93 of Vol. II. show apparently a Mediterranean release; and were there no other reasons for believing that these people practiced the tertiary release, it might be assumed that the Mediterranean release was also practiced. The reasons are, first, that in every case the arrow is pulled to the breast or even lower; and, second, and of more importance, in every instance when the archer is shown with the right hand toward the observer, the arrow is below the bow-hand, whereas in every case when the archer is shown with the left hand towards the observer, the arrow is above the bow-hand. The bow is represented vertically, as in all rude and early figures; but the artist, not being able to represent the bow foreshortened and horizontal, has unconsciously indicated the attitude of the tertiary release by preserving the attitude of the bow in relation to the hand.

We have seen that the Mediterranean release has two forms, in one of which three fingers are brought into action; in the other only two fingers are so used. English authorities say that if one can accustom himself to draw the bow with two fingers, a better release is the result. While the difference between these two forms seems slight, as indeed it is, yet the practice to-day among European and American archers is to draw with three fingers. It was evidently not so universally the form in Europe a few centuries ago; for at this time, judging from the few examples we have seen, the archers are almost always depicted drawing with two fingers. It is true, the directions in the works of these early times as well as allusions to the subject state that three fingers on the string is the proper method of release. Yet the few sculptures, ivory carvings, etchings, manuscripts, drawings, etc., to which we have had access, almost invariably depict the two-fingered release.

It would be interesting to know whether the bow has

become stiffer in later years, requiring three fingers to bend it, or whether (as more probable) the fingers have become weaker, thus requiring more fingers to do the work.

It is interesting to find in these early works a uniformity in the method of release employed, and that the Saxon, Norman, Fleming, French, English, Scandinavian, and Italian practiced essentially the same release.

Hansard says (see the "Book of Archery," p. 77), "All representations of archers which occur in illuminated manuscripts of the thirteenth, fourteenth, and fifteenth centuries — and I have examined some scores of them — identify the ancient with the modern practice. The pen-and-ink drawings of John de Rous, a bowman as well as contemporary biographer of that Earl of Warwick who, during the Wars of the Red and White Roses, was the setter up and destroyer of many kings, will furnish amusement and information to the curious. The necessary slight inclination of the head and neck — 'this laying of the body in the bow,' the drawing with two and with three fingers — are there correctly delineated. They may be found among the manuscripts in the British Museum."

According to Hansard, Ascham ordered the shooting-glove to be made with three fingers, "and when Henry the Fifth harangued his troops previous to the battle of Agincourt, he endeavoured to exasperate their minds by dwelling on the cruelties in store for them. Addressing his archers, he said the French soldiers had sworn to amputate their three first fingers, so that they should never more be able to slay man or horse."[1]

[1] Meyrick, in his famous work on "Ancient Armour" (Vol. I., p. 9), in speaking of the origin of the bow in England, says: "The bow as a weapon of war was certainly introduced by the Normans; the Saxons, like the Taheite at the present day, used it merely for killing birds. On this account, in the speech which Henry of Huntington puts into the Conqueror's mouth before the battle, he makes him stigmatize the Saxon as 'a nation not even having arrows.'"

The earliest figure I have met with, illustrating archery in England, was copied from the Saxon manuscripts in the Cotton Library. These manuscripts are of the eighth century. If the wood-cut contained in Strutt's "Sports and Pastimes" is correct, then the attitude of the hands shows distinctly the three-fingered Mediterranean release. The bow is short and thick, and has a double curve, something like the Roman bow, from which indeed it might naturally have been derived.[1]

The following examples have come under my notice in a very hasty and imperfect survey of the field, principally derived from books, engravings, and ivory carvings, reproductions, etc., in museums.

The celebrated Bayeux Tapestry, a copy of which may be seen at the South Kensington Museum, represents the archers in the attitude of the two-fingered Mediterranean release, though a few are shown using three fingers. Also the following show the two-fingered form of the Mediterranean release without exception: a fresco in Kumla Church, Vestmanland Co., Sweden, 1492; a sculptured figure in wood by Albrecht Durer, figured in Sommerard's "Arts of the Middle Ages" (5th Series, Plate xxvii.), also in the same work (10th Series, Plate xxv.); a chess piece in ivory supposed to be of the tenth or eleventh century; in Meyrick's "Ancient Armour" (Plate viii., Vol. i.), a figure of a Norman of the eleventh century, on the doorway of the Cathedral of Amiens, a cast of which may be seen at the Trocédero Museum; and, finally, in the Boston Museum of Fine Arts are a number of Florentine engravings of the early half of the fifteenth century, and these in every case represent in the

[1] It may be well to state here that opportunity has not permitted an examination of sources for early Roman releases. On Trajan's column a few releases are shown, and these are of the Mediterranean form.

clearest manner the two-fingered variety of the Mediterranean release. A curious form of the Mediterranean release is shown on the door of the Church of the Madeleine at Vezelay, a cast of which is to be seen at Trocédero Museum. In this release the archer has all four fingers on the string, the arrow being held between the second and third fingers. I had supposed that this was a mistake of the artist, as indeed it may have been, but Col. James Stevenson, in describing to me the methods of release among the Navajo Indians of North America, illustrated a release identical with this four-fingered variety.

In conclusion, it is interesting to observe that all the releases thus far described have been practiced from the earliest historic times. Each release with the exception of the primary release, which admits of no variation, has one or more varieties. The secondary release may have the second finger, or the second and third fingers on the string. Some forms of this release in India and Assyria show all the fingers on the string; it is hardly probable, however, that these are correctly represented. The tertiary release may have the first and second, or the first, second, and third fingers on the string. The Mediterranean release may be effected with two or three fingers, and in two instances all the fingers, on the string. The Mongolian release may have the assistance only of the first finger as in the Chinese and Manchu, or the first and second fingers as in the Korean and Japanese, — or, if rightly interpreted, the early Persian form, with the second and third only aiding the thumb; and if the Mongolian release described on page 161 be an established form, then we have here a mixture of Mongolian and secondary.

The persistence of a release in a people is well illustrated in the case of the Aino. For centuries the Ainos have

battled with the Japanese, and must have been mindful of the superior archery of their enemies; indeed on all hands, with the exception possibly of the Kamtschadals at the north, the Ainos have been surrounded by races practicing the Mongolian release, and yet have adhered to their primitive methods of shooting.

The releases vary in their efficiency and strength. The two strongest and perhaps equally powerful releases are the Mediterranean and Mongolian; and it is interesting to note the fact that the two great divisions of the human family who can claim a history, and who have been all dominant in the affairs of mankind, are the Mediterranean nations and the Mongolians. For three or four thousand years, at least, each stock has had its peculiar arrow-release, and this has persisted through all the mutations of time to the present day. Language, manners, customs, religions have in the course of centuries widely separated these two great divisions into nations. Side by side they have lived; devastating wars and wars of conquest have marked their contact; and yet the apparently trivial and simple act of releasing the arrow from the bow has remained unchanged. At the present moment the European and Asiatic archer, shooting now only for sport, practice each the release which characterized their remote ancestors.

Want of material will prevent more than a passing reference to a peculiar practice of archery which Moseley alludes to as pedestrial archery. It is a matter of common record that in widely separated parts of the world, as South America, China, and Africa, the archer uses his feet in drawing the bow. In an "Essay of Archery" by Walter Michael Moseley, 1792, the writer says: "It is recorded by ancient writers that the Ethiopians draw the bow with the feet;" and again, Xenophon speaking of the Caducians says: "They had bows which were three cubits long, and

arrows two cubits. When they made use of these weapons, *they placed their left foot on the bottom of the bow*, and by that method they drove their arrows with great violence," etc.

It is recorded of the Arabians that they used their bows in the manner above alluded to, by the help of the foot. The release in these cases must be of a most vigorous character; and when in some accounts the archer is represented as resting on his back, with both feet bracing against the bow, the string is probably clutched with both hands, after the manner I have provisionally called the archaic release.

In the following classified list of releases and the people who practice them, it is shown in a general way that the primary, secondary, and tertiary releases are practiced by savage races to-day, as well as by certain civilized races of ancient times; while the Mediterranean and Mongolian releases, though originating early in time, have always characterized the civilized and dominant races. The exceptions to this generalization are curious: the Little Andaman islanders practicing the Mediterranean release, and the inhabitants of the Great Andaman Island practicing the tertiary release, are an illustration. The fact that the various groups of Eskimo practicing the Mediterranean release, and so far as I know being the only people who have designed a distinct form of arrow for this method, is exceedingly curious. Mr. John Murdock, who is engaged in a careful study of the Eskimo, has expressed to me a surmise that certain arts of the Eskimo may have been derived from Greenland through Scandinavian colonists; and this might explain the anomaly.

It may be shown that in tribes in which the bow is but little used, and then only for small birds and game, the release is weak or irregular. The data, however, are altogether too few to establish any conclusions respecting this.

CLASSIFIED LIST OF TRIBES AND NATIONS REFERRED TO IN THIS PAPER.

RECENT.

PRIMARY RELEASE.

Savage.

Ainos of Yezo.	observed.
Demerara, S. A.	published.
Navajo, N. A.	reported.
Chippewa, N. A.	"
Micmac, Canada.	"
Penobscot, N. A.	observed.
Ute, N. A. ?	photograph.

SECONDARY RELEASE.

Savage.

Ottawa, N. A.	observed.
Zuñi, N. A.	"
Chippewa, N. A.	reported.

TERTIARY RELEASE.

Savage.

Omaha, N. A.	observed.
Sioux, N. A.	reported.
Arapahoes, N. A.	"
Cheyennes, N. A.	"
Assiniboins, N. A.	"
Comanches, N. A.	"
Crows, N. A.	"
Blackfeet.	"
Navajos, N. A.	"
Great Andaman Islander	published.

Civilized.

Siamese.	observed.

MEDITERRANEAN RELEASE.

Civilized.

European Nations.	observed and published.

Savage.

Point Barrow Eskimo.	reported.
Cumberland Sound Eskimo.	published.
East Cape Siberia Eskimo.	"
Little Andaman Islander.	"

Mongolian release.

Civilized.

Manchu soldier, China. . .	observed.
Cantonese, China. . .	"
Korean.	"
Japanese.	"
Turks.	published.
Persians.	"

Irregular release.

Temiangs, Sumatra. . .	observed.

ANCIENT.

Primary release.

Civilized.

Assyrian, early.
Egyptian.
Grecian?

Secondary release.

Civilized.

Assyrian, later.
India?

Tertiary release.

Civilized.

Egyptian.
Grecian.
Mexican?

Mediterranean release.

Civilized.

Assyrian, later.
Egyptian, early.
Arabian.
Indian.
Roman.

Middle Ages.

English.
French.
Norman.
Fleming.
Saxon.
Swede.
Florentine.

MONGOLIAN RELEASE.

Civilized.

Chinese.
Scythian.
Persian.
Egyptian. ?
Greek. ?

ARCHAIC RELEASE?

Civilized.

Ancient Greek.

It is hardly necessary to call attention to the importance of a more systematic study of the methods of archery and paraphernalia of the archers than has yet been done. I would point out the necessity of observing greater care in copying drawings, rock-inscriptions, frescos, bas-reliefs, etc., as to the minor details,— such as the position of the hand, the shape and character of the ends of the bow and arrow, and the shape of the feathers; also the possibility and importance of identifying among ancient objects and drawings arm-guards, thumb-rings, arrow-rests, etc. Travellers and explorers ought also not only to observe the simple fact that such and such people use bows and arrows, but they should accurately record, (1) the attitude of the shaft hand; (2) whether the bow is held vertically or horizontally; (3) whether the arrow is to the right or to the left of the bow vertical; and (4), of which no comment has been made in this paper, whether extra arrows are held in the bow-hand or shaft-hand. The method of bracing the bow is of importance also.

The remarkable persistence of certain forms of arrow-release among various nations leads me to believe, that, in identifying the affinities of past races, the method of using the bow may form another point in establishing or disproving relationships. By knowing with more certainty the character and limitation of the forms of arrow-release,

another clew may be got as to the date and nature of fragments of sculpture representing the hand. The peculiar attitude of the archer might lead to the interpretation of armless statues.

The author would be very grateful for any information regarding the methods of arrow-release of tribes and peoples. Particularly would he desire the release as practiced by the Veddahs of Ceylon, the Hill tribes of India, the tribes of Africa, South America, and especially the Fuegans. Indeed, any information regarding the methods of arrow-release in any part of the world would be acceptable. Such material in the shape of descriptions, photographs, drawings, and if possible specimens of bows and arrows, may be sent to the author, Peabody Academy of Science, Salem, Mass., U.S.A., for which full credit will be given in a future publication on this subject.

In addition to those already mentioned in these pages to whom the author is under obligations, he would mention Gen. Charles A. Loring, Mr. Edward Robinson, Prof. Otis T. Mason, Rev. W. C. Winslow, Mr. T. F. Hunt, Dr. W. S. Bigelow, Prof. John Robinson, Mr. S. R. Koeller, and Prof. E. F. Fenollosa, who have in various ways rendered him kind assistance.

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CONTENTS.

BULLETIN

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MR. TOPPAN'S NEW PROCESS FOR SCOURING WOOL.

JOHN RITCHIE, JR.

Read before the Essex Institute, March 15, 1886.

Ladies and Gentlemen, — Two years ago, almost to a day, I had the pleasure of discussing before you what was at that time a new process of bleaching cotton and cotton fabrics,—a process which, since that day, has been developed with steadily increasing value by a company doing business under Mr. Toppan's inventions. This evening [March 15] I desire your attention to a consideration of the effects of the same solvent principle upon that other great textile material, wool.

The lecture of two years ago was illustrated by the processes themselves, practically performed before your eyes. It is our intention this evening to follow out the same plan and to illustrate and, so far as may be, prove by experiment the statements which shall be made.

It is our intention to scour upon the platform various specimens of wool, and as well, to dye before you such colors as can be fixed within a time which shall not demand, upon your part, too much of that virtue, patient waiting.

Mr. Toppan, who needs no introduction to this audience, will undertake, later in the evening, the scouring of wool, and Mr. Frank Sherry, of Franklin, has kindly offered to assist in the work of dyeing. To those of you who are not familiar with the authorities in this country, in the work of dyeing, I need only say, that Mr. Sherry is an expert in his chosen business, and that his books are the standard in a majority of the mills in New England and in Canada. Inasmuch as the time necessary for dyeing is somewhat long,

Mr. Sherry will begin at once, in order that his specimens may be ready for your inspection at the close of the lecture.

Before proceeding to the discussion of wool, allow me to refer briefly to the principal statements of the previous lecture, of which this is indeed but a continuation.

A reduction in the time necessary for bleaching was claimed. This claim has been substantiated in practice. The process will bleach the goods in one half the time of the next best practical process. As to color and quality, you can judge for yourselves. I have brought here bleached cottons in the piece for your inspection. A bleacher of my acquaintance, who has no interests at stake, being engaged in a specialty with which these goods do not compete, has assured me that he considers the Toppan bleached goods as fifteen to twenty per cent better in a monetary sense, than the same goods by the old process. The white proves to be permanent; and when it is question of sewing the material, I am assured by ladies, that the ease with which it can be sewed, both by hand and on the machine, pays many times over for the trouble it is to find the article, which, as yet, has not secured a universal distribution throughout the stores.

The position of opponents to the process has changed. After the previous lecture, I was many times assured that, while the results of experiments with small swatches of cloth were very good, yet, on a large scale, the method would fail. This feeling or opinion has disappeared before practical results, and the question of cost is now raised. This is a consideration which it is not at all my province to discuss, but I can say in passing, that the Canton Company will give the Toppan bleach at the same price per yard as do the bleachers by the old system.

It has been and will always be urged against new chemical processes in the arts, that practice in the mill does not follow closely enough the experiments in the laboratory; that a process which can easily be applied to a small quantity of material fails, through inability to use it on a large scale. This was the objection urged against the cotton bleach, and I should not be surprised if it were urged against the wool scour. There is this, however, to be considered: in the scouring of wool, the mill reproduces very closely the conditions of this platform, or the laboratory. Instead of handling goods by the ton, as in cotton bleaching, the wool is treated in lots of a few pounds each, and the care which the experiment here will of course receive, will not be so disproportionate as in other cases. The laboratory experiments on cotton

have been confirmed in the mill, and by analogy we expect that, in the case of wool, the results will agree equally well.

The scour has been practically worked a number of times in establishments, some of which are to-day under contract to scour by this method, and it is from the lips of practical woolen men that I have evidence of the success of the scour on a large scale. When the date of this lecture was fixed, I hoped to be able to present to you the actual figures of several weeks' work, but the weather of the past two months, with the delay imposed by it upon transportation, has prevented the erection of the plant upon which I counted. The machinery is now set, but it is too early to give reports from it.

There is but little doubt that wool was in use before vegetable fibres, for the manufacture of fabrics, since it is, in its natural state, almost ready for the uses of a primitive people. It possesses fineness, flexibility, elasticity, — qualities not to be found in an equal degree in vegetable fibres in common use; and it is practically a process of little difficulty to render it fairly available for ordinary usages.

Its great difference, from a bleacher's point of view, lies in its susceptibility to heat, and the workman is, therefore, not able to apply to it the hot, lengthy processes which are used to whiten cotton. The strong caustics weaken the wool, and chlorine attacks it at the ordinary temperature, turning it a permanent yellow. These are the bleaching agents for cotton, and they cannot be used.

Wool is full of that grease and oil which serve to protect sheep against the weather, and usually bears with it quantities of dirt which mere washing fails to carry away.

The work of the bleach, or scour, as it is termed when it is question of wool, has varied little since its invention, and the industry was, in all probability, known to the Romans, who brought into England, at the time of their invasion, the art of working wool, their establishments being located where Winchester now is.

Wool scouring is simply a repetition of gentle treatment with soaps and lukewarm alkaline baths, and does not require a great length of time. The object of the process is to produce the whitest wool possible without loss of its elastic quality, or loftiness, as it is termed. At its best, the process of scouring, as practised to-day in our scouring mills, does not produce white wool, and furthermore, the scoured wools gradually yellow. When the wool is to be used for dyed goods in dark colors, the white may not be considered the most important requirement; but when white goods are de-

sired, the additional and disagreeable operation of sulphuring becomes necessary.

Mr. Toppan's method of scouring involves the use of two preparations: first, the compound; and second, the anti-compound, or as it has been termed, the S liquor. The compound is made from petroleum products, and is closely allied to the cotton bleach. This is a perfect solvent for the oil and fatty matter, and softens and disengages the dirt. The S liquor is a solvent for the compound and washes it out of the wool. A simple wash in cold water completes the process, which does not vary much from that in use to-day.

The scouring of wool (differing from the bleaching of cotton) is the first step in its manufacture, and in his work the scourer must have consideration for the succeeding operations. The better the condition of the wool for spinning, weaving, dyeing, the more successful the scour.

Mr. Toppan's scour is of such nature, that the succeeding processes in manufacture are prepared for in a remarkable degree.

We will consider first the process itself, then the advantages in the after-processes.

In the regular course of work at one of our woolen mills, I noted some time since a series of scours at about twenty minutes to the scour. This was said to be quick work, and the operator said that the stock (Cal. spring clip) was needed at once. The scour was, even to the inexperienced eye, somewhat imperfect. It was evident that the process had not been carried far enough to fully cleanse the wool, and sticking as it did to the squeeze rolls, it gave evidence of the presence of oil and gum.

The usual time for scouring is, I am informed, not far from half an hour, varying of course with the nature of the wool. With heat, and with strong alkali, the process may be shortened in point of time, but attempts to economize in this way are dangerous.

This I can illustrate experimentally, and the experiment is of interest to housekeepers, as well as to wool men. It is one of the first points which should be appreciated by wool scourers. I am rather loath to believe the statement which I have clipped from a trade paper: —

"It is a fact not generally appreciated by wool washers, that wool can be dissolved until nothing is left visible. Hot water alone will not do this, wool may be boiled without being dissolved; but put a little caustic potash, or anything of similar nature, into the water, even if it be far from boiling, and

the wool will rapidly disappear: the hotter the water, the more quickly it will melt."

This melting of wool is, indeed, an instructive experiment, and is of sufficient character to be shown, even upon the platform. It will require two or three minutes only, and I have prepared it for your instruction.

I have here an alkaline solution of twenty degrees Baumé. This little instrument measures the specific gravity of liquids, and is the common way of testing their strength. The alkali stands at twenty, Baumé, its temperature is 170, quite a little less than boiling. Water at this temperature is rather hot to hold one's hands in, but is not hot enough to really scald them. Into this liquid I drop a quantity of wool. In a short time the wool will be dissolved. Three minutes have sufficed in previous experiments, and I think it will be time enough in this instance. The wool disappears in the liquid, just as sugar does in your coffee. I pour this mixture through a glass funnel — you see that there are no lumps of wool in it. I pass it through a cold metal strainer, an operation that will show what has been done. The meshes have caught a white substance, which is a soap of wool. All fibre, or fibrous appearance, has disappeared.

The experiment is by no means a new one. Elwell, in his modern chemistry, published in 1806, speaks of a process which Chaptal had lately invented, whereby wool, instead of oil, was to be combined with an alkali to produce soap. The object was probably commercial manufacture of soap.

Now, in order to economize time, I have dissolved the wool in *strong* alkali. Other experiments, made especially for this occasion, give the following results: —

20	degrees	3 minutes.
15	"	3 minutes.
10	"	5 minutes.
5	"	25 minutes.

In these experiments there has been a considerable amount of instruction in other departments than the dissolving of wool. We tried some goods which were bought for all wool, and so warranted. It was astonishing how much material there was left after we had dissolved out all the wool, and it would not be surprising if, after all, some cotton had crept by mistake into these all-wool goods. At all events, it acted under the burning test exactly the same as cotton.

Now, in the washing of woolen fabrics, you can all apply the experiment without difficulty. I do not mean to insinuate

that there is a single lady here present who does not know a great deal better than I do about flannels and blankets and their treatment. But there are sometimes agents and assistants in our houses whose natures are poorly understood.

I have before me the directions taken from a package of well-known and much-used soap powder : —

" To each pail of water add one tablespoonful. If the water is hard, increase the quantity. Clothes wash easier if soaked over night."

I dissolved a tablespoonful of this powder in half a pail of water and the specific gravity was five degrees Baumé. In other words, twice the minimum direction quantity of powder produces an alkaline solution which will dissolve wool in half an hour, and with the liberty given in the directions to increase the quantity, and the knowledge that a larger quantity will perform the required work in a shorter time, servants, and even housekeepers themselves, may, and often do subject their clothing to a dangerous test, which, in proportion to the violence of the process, washes away — dissolves out — the wool. Soap powders are of value, but there should go with their use a knowledge of their nature, — an appreciation of what may result from careless application of their properties.

The experiment has shown, to a certain extent, the points which the scourer of wool must care for, heat and strength of alkali. Greater heat and greater strength are the temptations. The efficacy of heat is so great that it may well be believed that as high a temperature will be maintained as is outside the limits of real danger to the fibre. It is also evident that, to a certain extent, or rather within certain limits, the greater the distance from the danger heat, the better the results, and a process which will scour wool at a lower temperature has its advantages, in the better condition of the scoured wool.

The usual temperature to-day is from 130 to 135 degrees F. Mr. Toppan's scour produces its results at 120 degrees at the outside. This fact, of itself, assures greater strength of fibre.

The time necessary for scouring wool is, as I have stated, not far from half an hour. I have seen it done quicker, but really good results require about this time. Mr. Toppan's process has somewhat the advantage in point of time.

The capacity of a scouring machine, which I saw at work some time ago, is about 900 lbs. of clean wool in a day of ten hours. It was at work on Cal. spring clip. A short time before my visit, the same machine had turned out, with the same number of attendants, 400 lbs. of the same wool in three

and a half hours, or at the rate of 1,200 lbs. per day of ten hours. It is safe to say that the Toppan process can produce from one third to one half more wool in the same time, and from the same machine, than the old scour. I have seen a scour done in ten minutes actual time, but the machinery, running for the first time, so delayed the transfer of the stock from one vat to another, that the time of the whole scour was about equal to that of the process of to-day.

The scouring of wool is not an expensive process, so far as the chemicals used are concerned. The bill for labor is really of more consequence than that for the scour. I have had estimates from two or three different sources. From one mill I have an estimate that the cost of scouring is less than a quarter of a cent per pound; from another, and one of the best processes, the expense of scouring 2,000 lbs. of Texas wool is given as $2.79, or .135 cent, or a little more than an eighth. The expense of scouring 2,006 lbs. of the very same wool by the Toppan process was $5.07, or .2527 cent, almost exactly one quarter of a cent per pound.

Economy in the cost of the scouring liquor is not claimed by Mr. Toppan, but, on the other hand, an increase, at the outside, to twice the expense is conceded. But when it is known that the saving in oil will probably offset this loss, the disadvantage disappears. And then again, with the ability to produce in the same time, with the same plant, and the same force of workmen, twice or three times the amount of scoured wool, this disadvantage can hardly be urged.

With a material in use to the extent that wool is, a saving of any considerable amount of the material itself is an item not to be passed unconsidered.

It is a fact that wool scoured by Mr. Toppan's process yields a higher percentage of white scoured wool than do the scours of the day. Although the operation of wool scouring has been begun at Canton, it is to night too early to furnish comparative shrinkages from large quantities.

Shrinkage in wool is a variable quantity. It is different in different lots of the same wool, and indeed in different parts of the same fleece. In order to determine the comparative shrinkage from small lots, it would be necessary to take wool from the same lot and treat it by the old and the new process as nearly as possible under the same conditions. This result would be definitive.

The average shrinkage by the old process is, however, fixed from the results of many scours, and it is possible to state quite postively the shrinkage due to the scour.

When a sufficient number of scours have been made by the Toppan process, the average of these will be comparable with the figures now known with reference to the present systems. But if I cannot quote figures of my own, I have fortunately a series of experiments which are as reliable as anything can be expected to be under the circumstances.

Last year the *Manufacturers' Review and Industrial Record* of New York undertook a series of experiments which were conducted by their own men and, as they claim in their journal, for their own information only.

In order that an authoritative statement might be made to the trade, a series of tests and experiments was decided upon and Mr. W. B. Guild, the manager of their New England agency, was given entire charge of proceedings, with full authority to employ a dyer of his own selection to make any tests desired. The experiments were made for convenience at Canton and occupied several days. The utmost accuracy was maintained in the observations, and the weighing was done by Mr. Guild himself.

The results of these experiments I give in the words of the report as published in the *Record*: —

"The first test was taking $4\frac{3}{8}$ oz. of Texas fleece which was estimated to give a very heavy percentage of shrink. This was placed in the scour liquor at 120 deg. F. for five minutes, and then passed through an S liquor about one and a half to two minutes. There resulted from this $2\frac{1}{16}$ oz. of extremely clean, white, and handsome wool."

The loss in weight in the specimen, through shrinkage, was $38\frac{1}{2}$ per cent.

The other experiments are thus described, one of them being with a yellow buck fleece: —

"The yellow buck fleece was obtained for the purpose of getting the worst to scour that could be found. It was what is called a regular 'yellow bottom,' completely saturated with grease. The tags were very badly matted, and in order to get this fleece approximately clean and free from grease, with tags duly cleansed, etc., it required, by the old soda process, from twenty to thirty minutes, and even at that time the wool, though passably clean, was far from white or handsome. The average percentage of clean wool resulting from a number of trials by the soda process, made as fairly as possible, was $30\frac{1}{2}$ per cent clean wool.

"By the Toppan process, the same wool was scoured *perfectly clean*, at a temperature of about 123°, in time from two and a half to five minutes. This, when put through the S water (which worked as well, either warm or cold) for

about two minutes, gave a result in clean wool of $39\frac{9}{16}$ per cent. These tests were made with especial care to get an average of the fleece for each style of scour, to give the soda scour 130° to 135° of heat, giving each about the same amount of liquor per pound of wool; and giving the Toppan process from 120° to 130° of heat, the average being 120°, which was found to give most satisfactory results. In every case, after the two and a half minute or five minute scour by the Toppan process. the yellow buck fleece came out far handsomer and cleaner than by the soda scour, even at thirty minutes. The yellow tinge was also bleached out, which was not the case when cleaned with soda."

The old scour yielded about 30 per cent clean wool. The Toppan yielded less than 40 per cent clean wool, an increase of not far from one third in quantity.

"After this a number of experiments were made in washing a yellow buck fleece estimated to shrink about 69 per cent; also with an Australian merino fleece estimated to shrink about 45 per cent by former methods.

"The Australian fleece by the soda process gave $53\frac{2}{7}$ per cent clean wool; scoured by the Toppan process, it gave $61\frac{3}{7}$ per cent clean wool, a gain on the gross weight of $7\frac{1}{7}$ per cent in clean wool. or of the net clean wool, a gain of over 13 per cent in actual clean wool.

"Regarding the time for washing of Australian fleece, also the yellow buck fleece, we give the following tabulated statements, and have samples in our Boston office which show exactly the results produced.

"We have one sample each, scoured in the following manner, with the scour bath made up, as stated, one half ounce of Toppan compound to the gallon of water:—

AUSTRALIAN FLEECE.

Time.	Heat.	Result.
5m.	130°	Very clean and white.
2m.	135°	Extremely clean and white.
$1\frac{1}{2}$m.	123°	Handsomer than 20m. soda scour.
10m.	100°	Handsomer than 20m. soda scour.

YELLOW BUCK FLEECE.

Time.	Heat.	Result.
$2\frac{1}{2}$m.	135°	Very handsome.
5m.	130°	Very handsome.
$4\frac{1}{2}$m.	111°	Good.
15m.	100°	Handsome.

"The buck fleece, from its superior whiteness and in every way handsomer appearance, was in every case superior to the soda-scoured product, and in most cases so much so that it seemed incredible that it should have come from the same fleece."

While practice may or may not prove these percentages to be exact, it can be said that they were obtained by the most careful experiment, and to-day they represent our very best knowledge upon the subject. They point without doubt to a saving of some value in the weight of the scoured wool.

Wool product of the world in 1871 was....2,000,000,000 lbs.
Australian product in 1883............... 400,000,000 lbs.
United States in 1885.....................100,000,000 lbs.
Imports into United States in 1885.........100,000,000 lbs.

This will give some idea of the enormous amount of wool employed in our manufactures; and the process which can save to the consumer 10 per cent, or even 5 per cent, is of the highest value.

To show the power of Mr. Toppan's compound as a solvent, I have here one extreme example: At Hall's Mills, Hallville, Conn., some experimental scourings had been made with good result; more as a joke, perhaps, than in sober earnest, the superintendent said, "Well, I can give you something that you cannot scour," and he picked up a quantity of wool waste. This is torn from the wool in the different processes through which it goes, and is considered to be of absolutely no value. It is soaked with oil from the machines and the floor, and in practice is used as waste for wiping the machinery and is then burned. This was the material which was produced. I have some of it in this test tube, and I think that you can all see it or at least its color.

Mr. Toppan tried it by way of experiment, giving it a scour of three minutes' duration. The result I have here in this other test tube, and I think you can all see a difference. This cannot be cleansed by the old scour at all, yet it has a fairly long staple, and is an article of some commercial value. It is much better than shoddy for purposes for which shoddy is used, and is literally a production of something from nothing. As a test of the solvent power of the compound, it is striking in the extreme.

The opinion of an expert, with reference to comparative color and value, should not be passed over without comment, and the statement that the yellow tinge of the yellow buck fleece was removed, shows that the Toppan process is capable of better results in difficult cases than is the soda process.

And even further than this, the yellow tags have been scoured by Mr. Toppan, and put into condition to take light-colored dyes.

The white color of scoured wools is not permanent. When kept in stock, the scoured wool gradually assumes a yellow cast. The reason for this lies in the fact that in the scour, the animal oil is not all scoured out, and sufficient remains in the wool to come out after a time and show its color. It is a whitewashing, and, after a while, the natural color comes to the surface. The same is true of cotton. Cotton yellows, and there seems to be no way to prevent it, excepting at the expense of the fibre. Mr. Toppan's cottons, and his wools as well, retain their color. Specimens here have been scoured a sufficiently long time ago to prove this fact.

Wool scoured by this process is already mordanted for many colors. A mordant is a bond of union between material and the dye, and where there is dyeing of fabric or fibre, there is, I think, almost without exception, the preparatory process of mordanting. There are a dozen — possibly two dozen — shades which can now be dyed without mordant in some shape. In the case of wool, mordanting consists in boiling the wool for some hours in the mordant. It is pitched into vats, stirred, to secure an even distribution of the liquor throughout the mass, is forked out, and is then ready for the dyer.

This process, with the loss of time and with the injury to the wool that results from two handlings and a stirring, is completely eliminated in the Toppan wool. The compound is in itself a mordant for many colors commonly used, and enough of it remains in the fibre to prepare it for the dye. This is equally true of cotton, and, if you remember, at the other lecture, I had pieces of print which had been printed without mordant. The dyes take equally well on goods in the piece, without mordant. The saving in expense, by leaving out the mordant, is more than enough to pay for the scour.

The colors which need no mordant, when applied after Mr. Toppan's scour, comprise a very large variety of light shades, both in anilines and in wood colors.

Mr. Frank Sherry, who is here this evening, knows more about the dyeing of wool scoured by this process than any other man living, and has been experimenting for a year nearly, with these scoured wools. He can tell you all about it in the practical work, in the dye-room, and in the laboratory, and dyers can learn more from him, in this special feature, than from me.

I will simply give to you a few of the most salient points, and leave the technical parts, which would probably be of little interest to the major part of the audience, until I have finished, when Mr. Sherry will be pleased to answer any questions you may see fit to ask of him.

After mordanting the wool, it is put into the dye-vats, and remains in the hot dye for some hours. Throughout this time the wool is constantly stirred or poled, in order that the dye may take evenly. This poling is an injury to the wool.

The absorptive quality of the compound causes the dye to take more quickly, and it is evenly distributed. Mr. Sherry says: —

"The dyes take quicker, more evenly, with less poling, and probably with less dye. And further than that, the Toppan wool, being at least two shades whiter than any other scour, the color produced is proportionately brighter. The color is also permanent."

There are here wools done by Mr. Sherry, for Mr. Guild. They have been lying for nine months exposed to the light of two windows; one east and the other south, and within a couple of feet of the latter. There are some of the colors which are considered as rather hard to hold, yet a close examination fails to show any variation in shade. Here is yarn which was dyed in 1876 and has held its color.

There is another value to goods which are already mordanted, and that is with reference to household or home dyes. These dyes are very good under many circumstances, but they must be so put up as to be worked by the inexpert. They lie, therefore, under the disadvantage of not being mordanted, as a rule. The application of a mordant involves another process, and although in some instances the mordants are also given, yet this is usually not the case. The successful working of these colors without a mordant precludes the use of many beautiful shades, and they are as a rule quiet in tone. With goods which are already mordanted, the value of household dyes is largely increased. I have samples of wools dyed in these dyes, and to them I invite your special attention.

Wool scoured by Mr. Toppan's process has been woven a number of times in different mills in this country at dates as far back as 1878. And by the way, it is interesting to examine specimens which have been made this seven years. At these different times, there has been made a sufficient quantity of cloth to give substantial basis to statements which establish, without question, the value of the process, and which are of themselves of sufficient importance to work a change in

the method of scouring. In the first place, less oil is necessary in spinning. From a third to a half is saved; not a matter of great economy to be sure, but small as it is, it has been estimated that the saving in oil would just about balance the additional expense of the scour. In the second place, there is a material diminution in waste in carding. About one half of the card waste is saved, and the wool being cleaner, there is less gumming of the cards, and they need to be cleaned only about half as often. Third, the Toppan wool will spin finer than the same wool scoured in the ordinary way.

Mr. Spalding, superintendent of the Ray Mills at Franklin, informed me that he was able to spin from a run to a run and a half finer than with his own scour. A run with Mr. Spalding means some 1,600 yards more of yarn to a pound of wool. Finer thread, and more of it; in other words, a cheaper grade of wool when scoured by this process is available for the same purposes, exactly, as a finer grade scoured in the old way, — a saving of several cents per pound of wool. This is not the substitution of a poorer article for a good one, or, in other words, an adulteration, but it is an advance in methods of production, whereby really valuable qualities, now to some extent latent, are made to take their proper place in the manufacture.

The antiseptic quality of the compound in the case of wool, as well as with cotton, is a preventive of mildew.

The dirt which comes on the fleeces is, to a considerable extent, the excrement of the sheep themselves. This dirt often amounts to half the gross weight of the wool. This is not really dissolved by the compound, but is softened and held in suspension. In a very short time, if allowed to stand in quiet, the dirt is precipitated, and the precipitate is a fertilizer of high order. There is no doubt but that this alone, if collected, would pay the cost of scouring. As to the value of the fertilizer, I quote from the report of Mr. John L. Hayes, to the government, on Sheep Husbandry in the U. S., page 17: —

"As a fertilizer, the manure of sheep in its intrinsic quality, and its distribution and prompt utilization among the roots of grasses, is unequalled. This has been so long and so notably manifest, that the sobriquet of 'Golden Hoof' for the ovine animal has become proverbial. In England the sheep is the main dependence in the fertilization of the soil for the wheat crop. If the mutton returns barely suffice to pay for the field value of the turnip crop, the manure is deemed a liberal profit. Good farmers in this country understand the value of the sheep as a means of soil improvement."

The general advantages of Mr. Toppan's method of scouring wool are the following: saving of time in scouring; saving of strength of fibre through less heat; the wool is cleansed—it is made really white; the white is permanent; there is less loss of wool through shrinkage; the wool is mordanted for many colors, and the cost of mordant and time of operation are saved; the dyes seem to take more quickly and evenly; there is probably a considerable saving of dye; the colors are permanent; in spinning, less oil is needed; there is less waste in carding; there is less gumming up of cards; there is less waste in spinning; the wool will spin from one to one and a half runs finer.

In closing the lecture, and before proceeding to the practical work of scouring, I desire to call your attention to the fibres and fabrics which have been brought here for your examination. There are some of the results of the cotton bleach; there are some fibres, flax, and hemp; there are several different grades of wool in the grease, scoured by the Toppan method, and whenever it was possible to get the same thing precisely, scoured by other regular scourers for the trade; there are two large triple sets of wool and several smaller ones; the Guild samples; flannels, made by Damon, which he said were whiter than the usual ones were, after sulphuring; woolen cloths, woven in 1878; wool dyed by Barrett, and also with household dyes; and many other things.

Thanking you for your kind attention to the written portion of the lecture, I invite you for a while to the scouring-room and dyehouse which have been improvised here this evening.

THE CLIMATOLOGY OF THE UNITED STATES.

With especial reference to the difference existing between the climate of the Pacific slope and that of the country lying between the Rocky mountains and the Atlantic coast.[1]

[From a lecture delivered by FRANK R. KIMBALL in the rooms of the Essex Institute, January 18, 1886.]

THIS subject, owing to its comprehensiveness, can be treated only in a superficial way. The details and the differences existing between minor districts must be omitted. These of necessity would be included in a discourse devoted to the consideration of climate in regard to health, but in the present case we shall merely examine the chief characteristics from a meteorological point of view. The climate of a country has a greater influence upon the health and prosperity of the people than is generally realized. Man needs sunlight to maintain life, and air to breathe, food to eat and material for clothing. Next in importance to these fundamental necessities comes climate and this is an important element in the progress of mankind. None of the leading nations are situated in the torrid or frigid zones and no nation has advanced to high civilization without the concomitant advantages of a good climate and the foremost nations of to-day are those pos-

[1] In regard to the technical character of the following it should be stated that, in previous lectures on this subject, the speaker has omitted the elements of meteorology, considering at greater length kindred topics including a more detailed description of the Pacific coast climate; but, as questions which followed have shown a misunderstanding of important facts, it was thought best to devote a portion to these matters even though this should be done at the expense of a more popular treatment of the subject.

sessing the most favorable climatic conditions within the temperate zone. The greatest inventors, generals, statesmen and authors and the leaders of civilization are the product of the temperate zone.

The heat and the cold of the torrid and frigid zones enervate and stupefy men and retard development, so likewise, to a less extent, extreme variations of temperature in the temperate zone have an unfavorable influence. We appreciate the fact that the degrees of heat or cold and the dryness or dampness of the air affect invalids who are frequently sent to other localities, according to the nature of their trouble where these conditions are different; but it is also true that healthy persons are affected more or less by all weather changes. Many are affected by changes in temperature and others feel depressed during the passage of an area of low barometer though they may not be able to account for their feelings, therefore it becomes a matter of more or less interest and importance to know somewhat of other climates; and we find a great variety in different parts of the world. Some regions are very hot and others very cold; some have rain a large part of the year, in others it seldom rains; some are subject to great extremes of temperature while others have very little change throughout the year. In order to form an idea of the climate of any given place we must know a few of the laws governing weather changes, and then with the addition of whatever statistics we may have, a tolerably accurate knowledge of the climate can be obtained; but if we seek that knowledge blindly, by a few general reports, we are likely to be misled. It is frequently noticed that, in geographies, works of science and books of travel, the mean annual temperatures of places are given; such are worthless for our purpose. As an example we might take the mean annual temperatures of the two cities San Francisco and

Boston, these are very nearly alike and yet the climates of the two places are very dissimilar. In Boston, the thermometer in the heated spells of summer often marks one hundred degrees in the shade, while in the coldest winter weather the mercury often falls to zero and sometimes below, showing a variation during the year of over one hundred degrees; while in San Francisco, the variation from winter to summer is not much over forty degrees and the changes are much less abrupt. The same liability to error exists in judging of the rainfall, so we must know what figures we need and how to judge by the various statistics at our command. In order to explain the character of and the laws governing the various phases of the weather, I shall first describe our own climate and the operation of the United States Signal Service, and then the climate of the Pacific slope, supplementing the whole with a short consideration of the climatic changes which have been taking place throughout the world during the last few years.

Within the limits of the United States there exist three distinct meteorological regions. The first including that part of the country lying east of the Rocky mountains. This region has a precipitation of rain or snow at frequent intervals throughout the year; the greater part of the region has cold winters and hot summers; it is subject to variable winds at all seasons. The second region embraces the country lying between the Rocky mountains and the Pacific coast and north of New Mexico and Arizona. It has a wet and a dry season, the former occurring in the winter months; the precipitation is almost entirely in the form of rain, except in the mountains and is about one-half of that in the above-named region. The winters are mild and the summers cool on the coast and hot in the interior. The winds are variable in winter and westerly

in summer, appearing then like trade winds and are so called. These characteristics are more marked between the Sierra Nevada range and the Pacific coast. The elevated plateau between the Rocky mountains and the Sierra Nevadas, partakes somewhat of the character of the regions on either side; its rainfall is however less than either of these. The third region consists of New Mexico and Arizona; this like the last has a semi-tropical climate with a wet and a dry season, but these are reversed; the wet season occurring chiefly in July and August, the total rainfall, however, being very small. The winters are warm and dry and the summers hot except in the mountains.

Before proceeding to consider the Pacific climate we will note some of the chief features of our own variable climate. In the first place we shall notice that throughout the year, at intervals of every two or three days, especially in winter, we are visited by storms of large area occupying from twelve hours to two days in passing; these storms travel in about the same direction and act in about the same manner. A person who is an observer of nature and interested in the phenomena occurring about us from day to day, would naturally put the following questions? What causes these storms? Where are they developed? Where do they go? and what becomes of them? A few words and a few simple illustrations may make the subject plain in a general way.

It is often noticed on a summer day at the seashore, that the air will be quiet and warm, and in the afternoon the wind will start up from the eastward and refresh us with cool ocean breezes; this is owing to the air over the land becoming heated and rising, causing a current of cool air to flow in from the ocean to take its place; in this case we may have merely an afternoon breeze created which will go down with the sun. Again, we may take the case

of a great level plain heated by a summer sun till the air at some point commences to rise; as it rises air will flow in from all sides and will follow the upward current already created; in ascending, it will assume a spiral motion. This may be illustrated by taking a basin of water and allowing the water to run out through a hole in the bottom; the water will not flow in radial lines towards the hole, but in a curved line. And, again, if a column of smoke above a hot bonfire is noticed, it will be observed generally to rise in a spiral form; thus in the above case in the open plain, the air will rise in the same manner and currents will flow in from all sides, causing slight breezes along the surface of the ground. It is often noticed, on windy days, when the streets or roads are dusty, that little whirls of dust arise and travel for some distance; the action here is similar, but these, instead of being caused in a calm by the sun's action, are caused by conflicting currents of air; these of course being originally caused by the heat of the sun.

Atmospheric disturbances, similar to the above cases, occurring when the air is dry, will continue only so long as the sun remains above the horizon to heat the surface of the earth and the air. After sunset these will cool and the air will have no tendency to rise, hence such disturbances cannot develop into storms; but where there is moisture in the air the case is different.

It is a well-known fact that when water evaporates, heat is absorbed; hence we say evaporation causes cold. When the molecules of water separate and assume the vaporous condition, they need energy and so absorb all the heat they can. When condensation takes place, the molecules come together again and assume the cold, sluggish condition of a liquid, hence they do not need the energy to keep them in activity and the heat is given off again.

This latent heat plays a most important part in the production of storms.

In the above cases we have assumed that the air was dry. We will now suppose it to contain moisture to a considerable amount. Where the layers of air next to the surface of the earth become heated, the air rises and in so doing it expands and cools. The moisture condenses and we have clouds formed; but in condensing heat is given out which prevents the air from cooling as much as it would otherwise, therefore it continues to rise till it reaches a high altitude and overflows, passing off from the central spiral of ascending air; greater quantities follow and an activity is started by the new supply of heat which maintains the action after the sun has ceased to exert a direct influence; thus we have the development of a typical storm which continues day and night. Now, if we cut through this storm and take a horizontal section or ground plan, we shall see that in the centre is a calm of ascending air; about this a rain area and beyond this an area of clouds and we shall see that the winds rush in towards this centre. Therefore, on the north side of the storm we shall notice northerly winds, on the east side, easterly winds and so on, the storm appearing like a great wheel, with the exception that the winds, instead of following radial lines to the centre, as the spokes of a wheel do, tend to reach that centre by a more or less curved line, this curve changing according to the distance of the centre. At great distances from the centre the winds are drawn towards it in nearly radial lines, while of course at the centre the motion is nearly circular. This motion of the winds towards the centre is always in the opposite direction from the hands of a watch (that is, from right to left) in the northern hemisphere and from left to right in the southern hemisphere. Such are ordinary storms in all parts of the

world; they are called cyclones on account of their form, though many people improperly restrict the term cyclone to a tornado or a very severe cyclonic storm, whereas a cyclone may be of very slight energy and may only manifest itself to ordinary observers as a slight shower.

Having now noticed the formation of storms the next question would be, Where do they come from? In answering this question we may suppose two lines to be drawn, one just north of the United States running east and west, and another running south from the eastern point of the United States. From some point within these lines all our storms come; that is, all the storms in the north temperate regions travel in an easterly or northeasterly direction, therefore every storm which passes over New England comes from a westerly or southwesterly point. No storm ever comes from the northeast or east; the majority come from the region extending from the Gulf States to the northwest states. A few come from west of the Rocky mountains, but whether they come up the great Mississippi valley or across the centre of the country, or from the northwest, they almost always pass to the lake region and thence down the St. Lawrence valley. Besides these, there are what are known as the West India cyclones which come from a southwestern or sometimes nearly a southern point, following the coast to Cape Hatteras or Cape Cod and then passing off to the eastward over the gulf stream. These occur most frequently from August to December and are very apt to be severe. By bringing to mind the horizontal section of a cyclonic storm before described, it will be readily seen that as these storms approach New England and pass off to sea that the northern side is usually the only one felt, therefore as it passes away and the weather clears, the winds will back from northeast to north and northwest

instead of passing around to the south, southwest and west, as in the case of a storm passing down the St. Lawrence valley to the north of us. The majority of storms after leaving our coast travel to the northeastward, across the Atlantic and pass north of England. When a storm first develops it is of small area; but as it progresses from day to day its diameter increases and in high latitudes it disappears from this very fact; for when the diameter of the centre becomes so great that the ascending air does not overflow, but cools and sinks back into the centre again, the storm dies out.

Tornadoes are very destructive storms of small area and tremendous energy which frequent the centre of the country, being most destructive in Kansas, Illinois, Missouri and neighboring states. The South Atlantic states have also been visited by very disastrous ones, especially in February, 1884, when a great many people were killed and wounded and thousands of dollars' worth of property destroyed within a few hours. Until within the last few years very little has been known about the nature of these storms or the laws governing them; and it is only within the last two years that the Signal Service has attempted to give any daily indications of their probable occurrence for different localities. Their sudden development, narrow paths and short courses, together with their destructive force, have prevented very accurate observations until lately. What appears to be a thunder storm rises in the west and in the midst a funnel-shaped cloud appears suspended above the earth, moving up and down and swaying from side to side. The clouds above appear in greatest commotion, while an indescribable roaring is heard in the air. The storm travels like others, generally in a northeasterly direction, sometimes veering toward the north at the rate of about thirty miles an hour. They are liable to occur

at any time of the year, but are mostly confined to the summer months and are most frequent in June in the latter part of the afternoon.

The path of great destruction varies from 300 or 400 feet to a quarter of a mile in width, and the course of the tornado ranges from a few miles to 100 or 200 miles. When one occurs in the daytime it can be seen on the western plains a long distance away and its roar can be heard in time for the inhabitants in its path to escape. When it is seen approaching from the southwest a flight to the southeast will soon take one beyond the limits of its devastating path; but when one occurs at night the inhabitants either awake to find it already upon them or are often so terrified as to lose their self-possession and judgment, and thus lose the opportunity for escape to a place of comparative safety. For this reason, it is common to have "dug-outs" in the ground connecting with the cellar or close at hand, to which a family may quickly resort in case of danger. The Signal Service has enlisted the coöperation of town officers, postmasters and others in the regions liable to these visitations, and these parties act practically as voluntary assistants to the regular signal office observers in different parts of the country in collecting information and statistics in regard to every tornado visiting their locality.

After a tornado has occurred, the United States' observer at the nearest station will often make a series of personal observations, going over the course of the storm and taking the observations and accounts of eye-witnesses, and combining them with his own observations make out a report which is forwarded to Washington. In this way much valuable information is obtained and the Signal Service has been enabled to give within the last year or so indications of the probable occurrence of tornadoes in

which the percentage of verification has been very large considering the great difficulty of the subject, and very likely in this short period many lives have been saved. Many people in the east consider that the large destruction of property in the west by tornadoes is partly due to the light construction of the wooden houses there; but it should be borne in mind that brick and stone buildings succumb to these blasts almost as quickly as those of wood.

When a tornado strikes a building it generally tears it in pieces, carrying the débris aloft within the funnel-shaped cloud and throwing it out from the top to either side as it advances, leaving the wreckage of a homestead scattered along in a northeasterly line for distances, varying from a few yards to one or two miles.

It sometimes, however, happens that a house will explode by the expansion of the air within, as the rarefied air of the funnel passes over it, and the four walls will be thrown out in as many directions. This may occur frequently without being observed, as the parts may be carried away by the in-blowing currents and thus all trace of this action may be obliterated. Tornadoes have been found to travel in connection with some cyclonic disturbance to the north and their courses are generally parallel with the course of the main storm, though generally from 200 to 500 or 600 miles away. The theory which is now generally accepted is, that when a body of cool air flows southward and meets a mass of warmer air, it sometimes flows over instead of under the warmer air and in seeking a condition of stable equilibrium the warm air forces an opening through the stratum of cool air above, an interchange of positions thus taking place. Taking account of the temperatures, amount of moisture in the air and barometric pressures at the time, the Signal Service has

succeeded in sending out very correct indications in regard to the results likely to follow such given conditions; and during the last summer western farmers were enabled to go about their work without being needlessly alarmed at the sight of every ordinary thunder shower.

These storms within the past five or six years have been spreading over a greater area and becoming more severe. This is in part merely apparent from the spreading of the population over hitherto unpopulated districts and the greater number of reports received of these storms; but aside from this there seems to have been a greater display of this form of atmospheric disturbance than formerly. Besides cyclones and tornadoes, we have thunder showers and local showers which need no special explanation after what has already been said.

Having now noticed the principles of weather changes in our climate, we will devote a few moments to the consideration of the United States Signal Service and its work in collecting reports of the weather and deducing therefrom the bulletins and indications which are daily sent out to the principal cities of the country. When meteorologists and scientific men found that storms moved and acted in a somewhat orderly way and travelled in about the same direction, it became apparent to them that some plan might be adopted whereby vessels about to leave port might be appraised of the approach of severe storms, especially those from the West Indies, and, accordingly, a movement was set on foot with this object in view. On February 9, 1870, Congress passed a joint resolution authorizing the Secretary of War to put this scheme into operation and a weather bureau was established in the Signal Service to collect weather reports and issue warnings and probabilities of weather changes for the benefit of commerce and agriculture.

On November 4, 1870, the first weather bulletin was issued. On that day twenty-four stations sent simultaneous reports to the office in Washington and the bulletins were prepared and sent to more than twenty cities. There are now nearly five hundred stations scattered over the country from the Atlantic to the Pacific, and from the Great Lakes to the Gulf of Mexico. These are classed as those of the first order, second order, cotton region, mountain, river and seacoast stations. The main office at Washington keeps a continuous record by means of self-registering instruments. Stations of the second order like Boston and other principal points take six observations and send three telegraphic reports to Washington daily and one monthly by mail. Other stations take five observations and send three reports daily; still others take only one observation daily. The river stations report the height of the water at various points on the great rivers as indicated on a gauge which is placed on the bank and extends from the extreme low water line to the danger line; thus, the central office is kept informed of the condition of the great rivers and their tributaries, and is able to give notice of any probable rise or of any approaching flood in the river valleys, and river commerce is quite dependent on these reports. The cotton region stations, numbering between 100 and 200, take one observation, daily at five P. M. The seacoast stations take various observations, including the character of the waves, or the approach of swells which indicate the presence of a storm at sea and are often forerunners of cyclones coming up the coast. These stations also work in connection with the life-saving stations and are connected by a coast telegraph line and with the central office.

Storm signals were first displayed on October 24, 1871, a red flag with a square black centre by day, and a red

lantern by night is called the cautionary signal and denotes that a storm of considerable energy is approaching and that the wind will probably blow at the rate of twenty-five miles or more per hour. In this connection it should be noted that when the wind blows twenty-five miles per hour in Boston it may blow forty miles per hour off Cape Cod; therefore when a person in the city considers the warning not justified he should remember that it is displayed for the benefit of mariners, owing to the large number of vessels trading between ports scattered over an immense coast line extending from the provinces to the Gulf of Mexico. The display of signals at various points on that line is a matter of interest to a great many people having the care of a large amount of property, and when a very severe cyclone is coming up the coast the signal officer in a port like Boston, for example, not only displays the signal when he receives orders to that effect from Washington, but sends the police boat about the harbor to notify officers of vessels about to leave port of the character of the approaching storm. When the wind is expected to blow very strongly from the west or northwest the cautionary off-shore signal is displayed. This consists of a white flag with a black centre above the red flag already mentioned by day and a white light above the red light by night. The white flag alone indicates a cold wave. Of the display of these signals it may be said that about ninety per cent have been justified. When the wind does not attain a velocity of twenty-five miles per hour within the district the display of the signal is considered unjustified, yet the wind may attain nearly that velocity and so we may consider a larger proportion correct in a general way. The inland weather signals consist of three white flags, one with a red ball, one with a red crescent, and one with a red star denoting respectively higher temperature, lower temperature, and

stationary temperature, and three white flags, one with a blue ball, one with a blue crescent, and one with a blue star denoting general rain or snow, clear or fair weather, and local rain or snow. These are not displayed by the government but are recommended for use, and responsible parties willing to display them regularly will be furnished with daily telegraphic reports from the signal office for that purpose.

In the preparation of the daily weather bulletins a number of charts must first be made out and when it is considered that several hundred stations send in their reports it is not surprising that a large force is necessarily employed at the main office. Seven graphic charts in all are prepared showing the barometric pressures, the temperature, direction and velocity of the wind, moisture in the air, etc., at the various stations throughout the country. These charts then pass into other hands and the bulletin giving a synopsis of the weather throughout the country is prepared and the indications are made out and telegraphed to all the principal cities in the United States. The per cent of verifications of these indications has averaged a little higher than that of the storm signals. In addition to these telegrams there are the Farmer's Bulletins which are printed and sent to the smaller places by rail. In this work some forty railroad companies assist in distributing two-thousand or more bulletins daily; these are posted in conspicuous places by station agents, postmasters, etc.

In 1873 General Myers, chief signal officer, attended the Meteorological Congress at Vienna, a gathering composed of the officers of the various national weather bureaus of Europe, and representatives of scientific organizations. On this occasion he submitted a plan for united work, whereby a simultaneous record of meteorological conditions in differ-

ent parts of the world might be obtained from time to time or at regular intervals. The idea was favorably received and at the present time meteorologists are gaining considerable knowledge on the subject from the bulletins of the International Weather Bureau.

Before leaving the subject of forecasting weather changes, I will say a few words in regard to those who are known as weather prophets, men like Mr. Vennor and Mr. Wiggin who have enjoyed quite a notoriety at times. These men were not in the habit, as some have intimated, of sending out predictions, based upon nothing but the caprice of their own imaginations simply to attract public attention. On the contrary, they each had systems more or less worthy of scientific investigation and they themselves believed in their systems and at the same time endeavored to gain a reputation for accuracy in foretelling meteorological events. The late Mr. Henry G. Vennor, of Montreal, was a gentleman of learning, a Fellow of the Geographical Society, a naturalist and an author, having completed a record of meteorological observations extending over a period of many years. He found what appeared to be a series of recurring weather changes; that is, a period in which the weather would repeat itself, or go through the same changes as occurred in a former period: cold winters, hot summers, wet and dry seasons, etc., occurring in a certain order, through a certain number of years; these changes then being repeated throughout the next period of years, and so on. Mr. Vennor, however, did not disdain to seek aid for his predictions from other sources; and his knowledge in the field of natural history was of great advantage in enabling him to judge of the character of coming seasons from the migrations and appearance of birds, and the actions of animals and insects. He published a monthly bulletin and an almanac; these

contained a great deal of matter more or less interesting and instructive in regard to the weather, agriculture, etc.

Mr. Wiggin, who has been connected with the finance department of the Canadian Government at Ottawa, is an astronomer, and though not devoting so much time to meteorological work as did Mr. Vennor; yet he has made a number of predictions, some of his earlier ones proving correct and creating for him quite a notoriety. His predictions, however, are based not on the recurrence of weather changes, but upon the influence exerted upon the earth with its elastic envelope of atmosphere by the superior planets and other heavenly bodies. Without doubt there is much in such a system and although we might not be able to rely upon it entirely, yet not only the sun and moon, but the other heavenly bodies, exert an influence to a greater or less extent upon us, or the earth and air. The chief difficulty with which we should meet would be the reduction of these general facts to any practical system. In order to use them, we should know how much influence is exerted under certain conditions, and how that influence would manifest itself. In making predictions, weather prophets, on whatever system they work, refer to conditions which have not at the time begun to manifest themselves; whereas the Signal Service, as a general rule, draws indications of the increase and progress of conditions already developed.

Having now considered the principal features of our eastern climate, and the operation of the Signal Service, we will cross to the Pacific and note some of the peculiarities of that climate. After crossing the Rocky Mountains we find ourselves in what is called the great enclosed American basin, a plateau of 4000 to 5000 feet elevation, extending westward to the Sierra Nevada range. This region is mountainous, dry and barren in general, with a

few productive spots like the great Salt Lake Valley, which lies in the eastern part at an elevation of about 4000 feet above sea level. This valley is about the only locality here, capable of supporting at present any large population. Passing on to the west, we cross the great Alkali Desert; a region producing very little in the way of vegetation but sage brush. The rainfall in this section of the country is very light, ranging from eighteen inches at Ogden to four inches at Humboldt per annum, as compared with an annual precipitation in Boston of forty-eight inches; and as more water is lost here by evaporation than is furnished by the rainfall, the lakes, including Great Salt Lake, are gradually diminishing in size. The winters here are cool and the summers quite warm, but the extremes are not so great as in much of the country east of the Rocky Mountains, nor are the changes in temperature as great or as sudden. This condition appears to be the result of the relative position of the plateau with regard to the Rocky Mountains and the Pacific Ocean. We should expect to find it somewhat cooler than the lowlands of the great Mississippi Valley, but we also find that it is less subject to the violent fluctuations of temperature which we experience when warm areas of barometric depression are rapidly followed by cold waves from the west or northwest. The majority of these cold waves sweep down into the United States in a southeasterly and easterly direction from the northwest states and the region to the north, along the eastern slopes of the Rocky Mountains which here trend in a southeasterly direction. The region to the west of these mountains is subject to more or less change, but in a less degree; and again, the character of atmospheric changes, advancing from the west, would be influenced by the proximity of the Pacific Ocean which is milder than the Atlantic in the same latitudes, a matter which will be

considered later. Having reached the Sierra Nevada range, we find the western slopes very much more abrupt than those of the Rocky Mountains, and we descend very rapidly into the valleys of California. We are now in a region which possesses well marked climatic peculiarities.

The state of California is about eight hundred miles long and two hundred miles wide, with a coast line of a little over one thousand miles. Its surface is cut up by mountain ranges running parallel with the coast, and dividing the state into numerous long narrow valleys.

The prominent features of the climate are, first, a wet and a dry season; the former occurring in the winter months, while from May to October rainfalls are rare, and a shower in June, July or August, is of very unusual occurrence. Secondly, a small rainfall, the amount of precipitation in the rainy season being no greater than that of the corresponding period in New England. Thirdly, mild winters, snow being a rarity except in the mountains, and the climate in the southern part of the state being of a semi-tropical character.

The first question which would naturally arise would be in regard to the cause of the dry season. A person in the east is very apt to consider that the same causes tend to produce precipitation either in the form of rain or snow in all seasons, and when one finds a region where the rain ceases in the spring and does not begin again until fall, curiosity is aroused as to the peculiar conditions which cause a cessation of rainfall during a part of the year. In considering this question, several important facts must be borne in mind. In the first place, there is a tendency for weather changes to move in an easterly direction; and, secondly, the western sides of the continents are milder than are the eastern sides in the same latitudes. This may be partly due to the influence of warm oceanic cur-

rents coming from southern latitudes, flowing in a northeasterly and easterly course and striking the western coasts with a temperature above that of the surrounding water.

The mild climate of the British Isles is attributed to the influence of the gulf stream. There may be other causes, but these currents certainly have a considerable share in producing the effects which we notice. The gulf stream flows northeasterly at some distance from our coast, while a cold current from the Arctic regions passes southward between the coast and the gulf stream, consequently much of the influence of this latter stream is here counteracted. In the Pacific, a great ocean current exists similar to the gulf stream; it is called the Kurosiwo or Japan current, and flows from the coast of Japan in a northeasterly course towards the Aleutian Islands and Alaska, a small part passing into Behrings Sea and the balance sweeping down the Pacific coast of the United States. Owing to its great size, it preserves a very even temperature throughout its long course, both in winter and summer, and consequently has a marked influence upon the climate, not only of Alaska but of British Columbia and the regions to the south, giving these places very mild winters. Sitka, in the southern part of Alaska, corresponds in latitude to the northern part of Labrador, and yet its winter climate is not much colder than that of New York.

The average temperature of this current, as it reaches San Francisco, is about fifty-five degrees, and as it tempers the cold of winter it also mitigates the heat of summer; but here another feature of this climate, the trade wind as it is called, presents itself. This is in reality a continual indraught of air from the ocean during the summer season, caused by the rising of the air in the great

interior valleys to the eastward, which are very dry and hot at this season of the year. We may include in the list of localities contributing to this, the regions even to the east of the Sierra Nevada range, for it seems quite probable that the great enclosed basin before referred to may constitute quite an important factor in the case. It is true that in a large part of it the heat is not excessive, but the aggregate of thermal energy throughout such a large area would amount to considerable, and in the southern part the heat is quite sufficient.

The most favorable conditions, however, for producing this summer wind are to be found in the great valleys of the Sacramento and the San Joaquin; these two in reality forming one continuous valley, running north and south between the Sierra Nevada and the coast ranges. The temperature is very high here in summer and the coast mountains are comparatively low and a number of openings in the range admit a flow of air at a low level from the sea to the valley.

The principal opening through which this wind reaches the valley is that through which the Sacramento flows, on its way to the Bay of San Francisco; hence this bay and the adjacent localities are subject to much stronger summer winds than other parts of the coast north or south. Now, as we have seen, the temperature of the sea along the coast is quite low, and the winds passing over it are cool and do not absorb much moisture; and when they strike the land which at this latitude is quite warm, whatever moisture they may contain is absorbed rather than condensed; consequently rain is impossible as long as these conditions continue.

When, however, the interior regions cool in the fall, there is no longer a continued demand for this cool ocean breeze, and winds, more or less variable, take its place.

Rain occurs and the climate assumes characteristics more or less like our own, with the exception of the cold, as the Japan current still exercises its influence on the temperature, causing, as above stated, mild winters. Such is a brief explanation of the causes operating to produce the dry season in California. The dry summers and the mild winters are the distinguishing features of this climate; but, in addition, the claim is reasonably made that no other region of equal area offers such a variety of climates as the State of California. This might seem somewhat contradictory, especially when applied to the summer season, but even then a great change in temperature may be found by travelling from the coast inland or from the valleys up into the mountain ranges. It may be argued that various climates in one sense may be found in New England in summer, by travelling from the coast inland or among the White or the Green mountains. It is true that in New England as elsewhere, it is likely to be cooler near the seashore than inland, but aside from this the two regions are quite dissimilar. In New England, on the coast, it is at times as warm or nearly so, as in the interior, and places in the interior are at times as cold as those on the coast, while the moisture in the air causes mugginess in warm weather and chilliness in cold weather; hence all localities here partake more or less of the same characteristics. In California, though there may be slight changes, the permanent climatic features of different localities are more marked: for example, in San Francisco, although it has a somewhat disagreeable climate, we may expect about the same weather from day to day throughout the summer season; while if we pass a few miles to the south into the Santa Clara valley, we may, likewise, expect about the same weather from day to day, but it will be unlike that of San Francisco, and although

we may find disagreeable features in both, we may be very sure that they will not exchange places.

We should hardly expect to find in Santa Clara the fogs and the strong cold winds of San Francisco, while at the same time San Francisco was basking in the hot, clear air of Santa Clara. I have spoken of the dry air, especially in the interior, but we find along the coast a fog bank which encroaches on the land at night and retreats in the daytime; this is particularly noticeable at San Francisco. In the morning it extends some miles inland, the distance varying with the character of the country, the mountains offering a barrier to its progress. During the forenoon the land radiates sufficient heat to dissipate it and the rest of the day is bright. The fog bank, however, is likely to remain over the sea, appearing like a huge cloud rolling in towards the shore but not reaching it till sunset, when it spreads inland and a clear evening is uncommon. As we pass along the coast, away from San Francisco, the winds and the fogs become less noticeable, while if we go back into the Sacramento or San Joaquin valley we get beyond the reach of the fog, but we also lose the benefit of the cool breezes; consequently, the pleasantest climate is found nearer the coast, but at some distance from San Francisco.

The coast range sends out numerous spurs which form a broken line of hills or low mountains along the shore in many cases rising quite abruptly from the sea. Among these are many little valleys which are quite sheltered from the fogs and winds and yet are comparatively cool. Here we find small fruit ranches nestled at the foot of the hills or climbing the sides which are in some cases so steep as to necessitate terraces, and here and there are mineral springs and pleasure resorts on a small scale for summer and

winter. The position of these mountain ranges running north and south in connection with the steady westerly wind produces (as has been stated) a great variety of temperatures. In San Francisco the thermometer registered 80° not more than five or six times in the summer and the average would be about 75°. When the interior valleys become a little cooler the trade wind becomes weaker and the weather warmer. On this account July and August are the coolest months and June and September are generally a few degrees warmer.

What are called dog days in the east are scarcely known on the Pacific Coast. When we reach Sacramento we experience a summer heat of 90° and as we go north or south towards the heads of the two great valleys we get beyond even the slight influence of the trade wind which Sacramento feels, and the temperature rises to 100° and over, and occasionally the mercury registers 110° in the shade; but, owing to the dryness of the air, a temperature of 100° is no more trying than one of 85° in New York, and this region has the advantage of cool nights; though the people of Sacramento have a mid-day heat of 90° they find blankets necessary at night.

The winters here are colder than on the coast but the rainfall is less, averaging about nineteen inches only; these valleys sometimes have nearly two hundred and fifty clear days in the year without fog or clouds. The rainfall increases from the southern part of the state towards the north. It is greatest near the coast, and is generally more on the western sides of the mountains than on the eastern; the amount is however quite variable from year to year. It averages in San Francisco twenty-three and one-half inches, at Santa Barbara fifteen inches, at Los Angeles twelve inches, at San Diego ten inches, and at Colton nine inches per year. The Los Angeles region

like Nevada and Arizona is subject to occasional cloud bursts when the water comes down in a deluge carrying everything before it. These generally occur in the mountain canyons and small valleys and have not been known near the large towns, though the railroads and towns suffer from the rapidly rising streams at such times. Sand storms also occur here as they do in the San Joaquin valley. To the east of southern California lies the Arizona meteorological region in which the small rainfall occurs in summer; this season is excessively hot except in the mountains. The mercury in a few places sometimes reaching 120° in the shade, and the hot days are followed by hot nights; the southern part, however, has a fine winter climate the mountain districts being cold. The mean July temperature of Yuma, which is in the lowlands, is one hundred and four degrees and the rainfall at this place is only four inches. Between this region and southern California lies a desert which is influenced by the dry winters of the former and the dry summers of the latter. A year or more has often passed without rain, but an occasional cloud burst supplies the country with an unwelcome amount in a few minutes; coming in this way little good is done, and no vegetation is produced here. As I have stated Nevada and Utah differ somewhat from California in climate, so also Colorado and the western parts of Texas partake somewhat of the climate of the Arizona region, but the classification of the three principal regions of the United States already made is sufficient in a general way.

It remains to be stated that the above characteristics and statistics refer to the weather in its normal condition, but a change has been taking place throughout the world during the last five or six years, which the majority of meteorolo-

gists have as a general rule refrained from considering with the exception of some of the phenomena resulting therefrom. We may consider that somewhere about the years 1880, 1881 or 1882, we entered a cycle of astronomical disturbance, and this fact has manifested itself in the unusual terrestrial and atmospheric phenomena which we have witnessed in this period. The climatic changes occurring in various localities have been noticed and commented upon, but no general explanation has been given by the leading meteorologists to whom people look for information in such matters. Local changes have been attributed to local causes, and peculiar phenomena like the "Yellow Day" have been explained to the satisfaction of many, but not in a way to comply with the conditions in the case. The "Yellow Day" occurred in New England in September, 1881. I was at Marblehead Neck at the time and had a fair opportunity of observing the phenomenon. When I awoke on that morning I discovered the harbor and the surrounding landscape bathed in a most peculiar yellow light. This continued throughout the day. The grass appeared blue and all colored objects had a strange appearance and the atmosphere was very still and oppressive. People were at first unable to give any explanation or form a theory in regard to it. Men who went to their business in Boston returned with accounts of the peculiar aspect of the city where gas was used in many places throughout the day. The papers gave descriptions of it, but no adequate explanation. The superstitious believed the end of the world was near at hand, and the members of one religious sect prepared to ascend, and waited patiently all day. More practical people, particularly those who had been in tropical regions, expected that an earthquake or a hurricane would follow, but nothing of the kind took place; and when the sun had set, the strange light

lingered but a little while and the moon and sky then appeared as clear as usual.

A theory was then evolved and adopted to explain this appearance. It was to the effect that owing to the extensive forest fires then raging to the north of New England, a great quantity of smoke had drifted to the south and east over the country, thus producing the yellow light; and in support of this theory it was stated that many persons noticed an odor of smoke and that in New Hampshire it was particularly strong. As no better explanation was offered it was accepted generally. Nevertheless, it would not satisfactorily stand a test.

The ordinary ruddy glow of sunset is simply caused by the way in which the rays of light penetrate the atmosphere which is apt to contain considerable moisture; but when we have to deal with a phenomenon like the Aurora Borealis (or northern lights) we find we have a more complicated subject to analyze. We can scarcely say that the light is caused by the presence of gross foreign matter in the air, unless we class magnetism and electricity as such. This light at times appears in the form of a few streamers or an arch of white light. At other times it will rise to the zenith and even stretch over towards the south. Occasionally, it spreads over a large part of the distance between the east and the west, and at times it assumes a reddish hue, and the flickering and darting motions of the streamers or rays are very common. It has been noticed that a brilliant display of this kind often accompanies or follows a sun storm, that is, a disturbance in the envelope of the sun, such as may be witnessed in the development and expansion of a so-called sun spot. A change of weather or of temperature is also looked for, after a display of northern lights. This subject is little understood, yet we can but feel that a bond of sympathy exists throughout the

solar system and that oftentimes unexplained phenomena are but the manifestations of reactions between the members of that system. Now to revert to the subject under discussion; it appears to me quite necessary to attribute the cause of the "Yellow Day" to something higher than smoke in the air, and I will mention a few facts which seem to make the smoke theory untenable.

In the first place, it is granted that in the neighborhood of an extensive fire the sky assumes a murky hue from the smoke; but there have been many forest fires of great magnitude in the regions to the northeast, north, northwest and west of New England without being followed by any such conditions as were present on the "Yellow Day." It is claimed that the wind was not in the proper direction on these occasions, but that on the "Yellow Day" it was.

Now let me say that though there may possibly have been a little smoke in the air in northern New Hampshire and Vermont, yet the yellow light of that day appeared over other parts of New England nearly simultaneously. If smoke had been the cause, we should have had a gradual thickening of the sky, as the smoke advanced from one district to another southward and it would have passed away in the same gradual way. Such was not the case; it appeared in a short space of time and disappeared with the sun. Furthermore, if the wind had been violent enough to have brought such an immense volume of smoke down over New England and carried it away so suddenly, then that wind, even if at a high altitude, must have caused some motion in the air next to the earth. But the air was calm on that day, and, again, if such an amount of smoke had been carried along over so large a territory in so short a time, it would have presented more the appearance of masses of clouds

driven before a strong wind, whereas there was very little appearance of that kind.

The yellow light seemed to be equally diffused over the heavens and at rest, though there occurred now and then whitish spots or what appeared to be breaks or openings in the yellow expanse, but no definite outlines were visible and the difference in the tints was so slight as to amount to no more than the variations in the sunset glow or the breaks in the white expanse of the northern lights.

A number of persons claimed to have noticed the odor of smoke in the air, but I think they may have remembered such a fact after being informed of the smoke theory, and one might quite readily imagine smoke in the air when it was so close and oppressive as on that day. In the northern part of New England I doubt not, there may have been more or less smoke in the air, not only on that day but for some time, not, however, in sufficient quantities to cause such a sudden and extensive combination of atmospheric conditions. Such facts we may consider as negative proofs. Let us now see if there are any cases in which such appearances occur without the presence of smoke. We have only to seek such information from a sea captain or some one who has been in tropical regions, and we shall find that a calm, sultry air and a brassy appearance of the heavens often occur before elemental disturbances of great violence, and even here in New England we have occasionally noticed such appearances before the breaking of a heavy thunder shower; and when we find that in some regions a calm, sultry air with a yellow light in the heavens continues for some time without the presence of smoke and is generally followed by atmospheric disturbances, we are led to believe that such conditions are produced by the same agencies, and that as these are variable, it is possible for the above appearances to exist

under certain circumstances without the attendant disturbances.

Another fact in connection with the "Yellow Day" is that the same yellow light was observed within a day or two after, in Virginia and then in Iowa. In the latter state the light had a flashing appearance like the northern lights in activity. It certainly seems quite unreasonable to suppose that smoke came down to New England, then passed to Virginia and then over to Iowa. The only satisfactory way to account for it is, as above stated, on the supposition that it was caused not by the mere interference of gross matter held in suspension in the air, but by the same forces and conditions which are concerned in the production of many other singular terrestrial and aërial phenomena, and which may have much to do with the aurora borealis and the red afterglows at sunset which have attracted so much attention within the last two or three years. These brilliant results began in the fall of 1883, appearing in India in September, and being very marked in October, November and December, not only in Asia, but in Europe and America. The display began when the ordinary ruddy glow of sunset had faded; then a deep red light illumined the western sky, extending at times even to the zenith. A writer, describing the appearance in New England, says: "The display was almost startling and there was something almost bewilderingly grand in the evidences of the red glow. It was at almost six o'clock that the most peculiar phase of the phenomenon was witnessed, when in the starlit sky the peculiar ruddy glow came and went. The coldly brilliant stars seemed blue and green by contrast with red and their brilliancy was fantastically magnified." Astronomers and meteorologists here and abroad advanced different theories and each seemed plausible. Prof. Piazzi

Smyth, Astronomer Royal for Scotland, maintained that there must have been an excessive amount of vapor in the higher atmosphere caused by unusual meteorological conditions. The "New York Herald" also strongly supported this theory, while other leading astronomers claimed that the cause was to be found in the volcanic dust thrown up by the great eruption in the Island of Java. This theory has perhaps been more generally received than any other. Mr. Norman Lockyer, Professor Ball of Dublin and Mr. Raynard being among its supporters. Professor Loomis was not inclined to endorse either of these theories. It has also been claimed by several scientists of high standing, that the earth passed into a stream of meteoric dust about the time of the beginning of these displays, and others have sought the cause in the attenuated matter of a comet's tail in the atmosphere. The theory of volcanic dust from Java has, however, as above stated, been the one most universally accepted, and yet that seems scarcely adequate to explain the matter fully, for the eruption took place August 27, and three days later these afterglows were seen in Brazil, over nine thousand miles from the disturbance, and if the wind had borne the dust thither it must have travelled at a great speed; and, furthermore, it must have travelled rapidly in various directions to have produced such results in Asia, Europe and North America as well, and there have been reports of such appearances before the earthquake. And, again, if the upper atmosphere had become so permeated with foreign matter, it seems very strange that the effects should not have been noticed every day. As it was, several days often passed without the display, followed by one or a number of successive brilliant afterglows, which at times assumed the motions of the northern lights, streamers of red darting upwards, and then retreating in a man-

ner different from the ordinary changes of sunset hues, and scarcely to be accounted for on the mere supposition of light passing through a veil of suspended volcanic dust.

On the whole it appears quite as reasonable to suppose that the cause which produced the great earthquake of Java also produced atmospheric phenomena at the same time, and it does not particularly affect the case whether, as is generally supposed, the causes of earthquakes exist within the earth or whether, as is not improbable, outside influences are largely concerned in their production, or both. In referring to the matters above my object has been to show that unusual phenomena have occurred within the period before mentioned, and numerous other cases might also be cited; one or two of the principal ones I will hastily consider in order to make the case more distinct. The eruption of Krakatoa in Java in the summer of 1883 was the most powerful convulsion on record. Other great catastrophes have occurred within the last century or so, such as the great Lisbon earthquake of 1755; the Java earthquake of 1815, and that which devastated the western coast of South America in 1868; but the one we are considering destroyed more human beings and its disastrous action continued for a longer time—one-hundred thousand persons were killed. A range of mountains disappeared beneath the sea and the topography of the whole country and the neighboring regions was changed, so that mariners knew not where they were; waves rolled where dry land had formerly been, and land appeared where vessels had sailed, while the sea for a long time after was covered for miles upon miles with a layer of pumice stone and ashes. To this may be added the earthquake of England, which though slight in comparison with the above, was an unusually severe one for the country in which it occurred. The disastrous floods and tornadoes in the United States

within the last five years have been unparalleled in the history of the country, and the frequency of severe storms all over the world has been very unusual. In January, 1884, a paper was read before the Academy of Sciences at Paris, giving a review of the year 1883. The following lines are taken from a synopsis of this paper.

"At the last January session of the Paris Academy of Sciences, M. Foye gave a rather startling summary of recent physical commotions both on the earth and on the sun. Among the numerous exceptional phenomena noted for some time such as the frightful volcanic explosion of Krakatoa, the immense sea waves and air waves which swept round the globe, and the strange celestial lights and colorations, he mentioned that the month of January in Europe resembled in temperature the month of April, while systematic observations disclose singular variations in sun-spot frequency and no less singular behavior of the magnetic needle. During the present summer in the southern hemisphere extraordinary heat has been recorded, the thermometer at Buenos Ayres rising in the shade to 101° and in Queensland to 106°. In consonance with the disturbed state of the earth, M. Wolf of Zurich reports two pronounced sun spot maxima in April and October last, and only four days in 1883 in which the sun was not spotted. Though these maxima were not so high as that of April, 1882, and there are now indications that the sun's activity is decreasing, physicists will not be slow to connect the terrestrial disturbances with the solar storms. The French scientist may now add to his list of strange phenomena the late unparalleled Ohio floods, the extraordinary southern tornadoes of recent date, with the reported death roll of several hundred persons and the phenomenally early and extensive efflux of Arctic ice upon the Atlantic." The above extract points quite plainly to the fact

already mentioned, that is, the relation existing between the members of the solar system. If a sympathy exist between the sun and the earth, it must also exist between the sun and the other planets, and if changes in the sun affect these it is not unreasonable to suppose that they in turn may exert some influence upon the sun, and if they ever do, we should expect the effects increased when the superior planets occupy such positions with regard to one another as they have within the last five years. Now after these superficial observations, I will refer to my former statement that the characteristic climates of the different sections in the United States which I have described, have not within the last few years been in their normal condition. As an example the dry season in California has been growing shorter, the rains have continued later into the spring, and commenced earlier in the fall, and light showers have occurred in June and last summer a light one occurred the first of July, and in some localities in the state thunder and lightning accompanied it, a remarkable event for that region. A Spaniard who had resided in Monterey most of his life stated that he had never seen lightning until two years ago. The Californians boast of their freedom from thunder showers; light ones occur though very rarely but the state is subject to eight or ten earthquake shocks a year. These, however, are generally light, and in the majority of cases are scarcely noticeable, and the residents prefer them to thunder showers. In support of this preference they bring up the undeniable fact that in twenty years only forty deaths from earthquakes have occurred in the state, and these mostly by the falling of old adobe houses, while in the rest of the United States subject to thunder showers the deaths by lightning amount to nearly one hundred and fifty a year, and if the deaths by tornadoes be added, the total would

be from 250 to 300 a year and sometimes more. Of course there always exists in California the liability of a severe earthquake, but though showers have taken place there lately, they are not likely to develop into any such severe and frequent electrical storms as are experienced elsewhere. Changes in our own climate are also quite plain: for several years our proverbial April weather has been a stranger. We have not had mild days with typical April showers and bright blue skies alternating in rapid succession, as formerly, but instead, we have had cold rainy Aprils more like November, with a few instances of unseasonable heat; and again, our winter season formerly preserved its characteristics in a regular and orderly manner. The snow came and the cold came and remained in quite an even way. We were accustomed to have sleighing through a large part of the winter, and we expected a short thaw of two or three days in the early part of January known as the January thaw, but of late years we have had very little continuous sleighing here, some years having very little snow and at other times having the larger part of it in one or two heavy storms. Our thaws have occurred every few days, nearly every snowstorm being followed within a day or two by one; cold waves and warm spells alternating in rapid succession. The present season has possessed more or less the true winter features, but we have had an alternation of many very severe storms, very cold waves, and warm spells. On the whole, the winter has been a cold one with considerable of the old time regularity in its snow falls, but nearly as changeable as others of late. This changeable and uncertain weather of the last few years has caused an unusual amount of sickness everywhere. The influences bringing about these changes have also manifested themselves in other ways.

The most important agents of climatic change within the

control of man are the forests. These have an important bearing on the climate of a place and their wholesale destruction is apt to create an unfavorable change. This is confined chiefly to the temperature and the prevalence of droughts and floods. In the case of the latter in a deforested region, the effect, so far as the destruction of the forest is concerned, is not produced by an extra amount of precipitation but by the water reaching the streams more rapidly; and it often happens that barren regions suffer most from floods, other things being equal. It should be noted, however, that many of the unusual floods of late years have been caused by very heavy rainfalls on account of the abnormal conditions which we have been considering, but the results have been more marked in scantily wooded regions than they would have been had the hills been covered with a heavy growth of timber. It has been quite strongly maintained by some authorities that forests do not actually cause more rain; but if they do not in a direct way, they do indirectly, and numerous examples are afforded us for observation while the evil effects of forest destruction are too common. Whole districts which once were rich and productive have become dry and barren, their streams have dwindled to mere brooks, except after heavy rains, when they rise rapidly and sometimes overflow and the soil is gradually washing away from the hills. The effect in temperature varies somewhat with the surrounding conditions. The clearing of forest lands in Germany had the effect of raising the temperature. In England the same result followed, but in Iceland the temperature has been lowered. It may be said, however, as a rule that a forest equalizes the annual temperature as well as the distribution of the rainfall.

About ten years ago I wrote an article, calling attention to the importance of united work for the preservation

of our already rapidly decreasing forests; and localities, which I then had in mind, have since been denuded of their timber, and the changes, above mentioned, to a certain extent, have been the result. The destruction of forests could not cause all the varied and unusual meteorological phenomena which we have been considering, yet a corresponding influence is contributed to exaggerate all abnormal weather changes. The "arbor days," instituted of late in a number of our states, are the result of excellent ideas, and if they are generally observed will be of great benefit in creating an interest in the subject.

I think many would find a source of recreation in the subject if their interest were once aroused. It is not only important from a climatic and sanitary point of view, but it is a very instructive and interesting study in other ways; and the organization of local societies, composed of both sexes, devoted to the study of forestry in all its branches, including botany, with the intention of making practical use of the knowledge thus gained by means of united work, would eventually bear as much fruit as many of the other societies organized for various purposes in our different cities and towns. But the subject of forestry is too vast to be considered at any length within the limits of the present discourse, and as I have been expected to confine myself to meteorology I have not digressed from that subject, and I will close with the hope that the questions which I have endeavored to explain have been made clear.

BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 18. SALEM: APR., MAY, JUNE, 1886. NOS. 4–5–6.

ANNUAL MEETING, MONDAY, MAY 17, 1886.

HELD this evening at 7.30 o'clock. The PRESIDENT in the chair. Records of preceding meeting read and approved.

The annual reports of the Secretary, Treasurer, Librarian and Auditor, were read and accepted.

The committee on nominations reported the following list of officers proposed for election. A ballot was taken and the ticket as reported was elected.

PRESIDENT:

HENRY WHEATLAND.

VICE-PRESIDENTS:

ABNER C. GOODELL, JR.
FREDERICK W. PUTNAM.
DANIEL B. HAGAR.
ROBERT S. RANTOUL.

SECRETARY:

GEORGE M. WHIPPLE.

TREASURER:

GEORGE D. PHIPPEN.

AUDITOR:

RICHARD C. MANNING.

LIBRARIAN:

WILLIAM P. UPHAM.

CURATORS:

History—HENRY F. WATERS.
Manuscripts—WILLIAM P. UPHAM.
Archæology—FREDERICK W. PUTNAM.
Numismatics—MATTHEW A. STICKNEY.
Geology—BENJAMIN F. MCDANIEL.
Botany—GEORGE D. PHIPPEN.
Zoölogy—EDWARD S. MORSE.
Horticulture—
Music—JOSHUA PHIPPEN, JR.
Painting & Sculpture—T. F. HUNT.
Technology—EDWIN C. BOLLES.

COMMITTEES:

Finance:

The PRESIDENT, *Chairman ex off.*
The TREASURER, *ex off.*
GEO. R. EMMERTON. DAVID PINGREE.
HENRY W. PEABODY. WILLIAM MACK.

Library:

E. B. WILLSON. HENRY F. KING. B. F. MCDANIEL.
WILLIAM D. NORTHEND. THEODORE M. OSBORNE.
The LIBRARIAN, *ex off.*

Publication:

EDWARD S. ATWOOD. JAMES A. EMMERTON. EDWIN C. BOLLES.
J. S. KINGSLEY. HENRY M. BROOKS. T. F. HUNT.

Lecture:

ROBERT S. RANTOUL. FREDERICK W. PUTNAM. A. L. GOODRICH.
FIELDER ISRAEL. WM. NEILSON.

Field Meeting:

The SECRETARY, *Chairman ex off.*
GEORGE A. PERKINS, Salem.
GEORGE COGSWELL, Bradford.
FRANCIS H. APPLETON, Peabody.
NATHANIEL A. HORTON, Salem.
GEO. A. BATES, Salem.
CLARENCE E. MURPHY, Salem.
FRANK R. KIMBALL, Salem.
EBEN N. WALTON, Salem.
WINFIELD S. NEVINS, Salem.
JOHN H. SEARS, Salem.

Mr. HAGAR, from the Board of Directors, presented and read the following report which, he said, had the cordial endorsement of the Directors.

" The sub-committee of the Directors of the Essex Institute appointed at a meeting holden April 16, 1886, would respectfully submit the following report.

The Salem Athenæum, the owners of Plummer Hall, on the 25th of May, 1885, gave the Essex Institute the two years' notice of the termination of the present contract between the two societies. The accommodation of the present Plummer Hall building being insufficient to meet the requirements of both societies, the Athenæum needing the whole of the second story for the proper arrangement of its library and reading-rooms, it was thought advisable to secure accommodations for the Institute library elsewhere.

The finance committee of the Institute was therefore authorized to negotiate for the purchase of the Daland estate, which purchase was duly effected and the proper deeds passed. In devising plans for the utilization of the purchase, it was deemed a fitting opportunity to attempt to obtain a public library for our city. A joint committee on the part of the Athenæum and the Institute was appointed to prepare a plan looking to the union of the libraries of these societies, the coöperation of other library organizations, and the city government. The plan proposed by such committee, not meeting with the unanimous approval of the proprietors of the Athenæum, and it being deemed unadvisable without such approval to carry the plan into effect, the committee was discharged from consideration of the subject.

It now devolves upon your committee to propose a plan looking to the establishing of the Essex Institute in its own building, which should be at once prepared for its accommodation, and in general terms, to say, that the Daland estate can be so prepared at moderate expense; plans have been drawn showing the proposed alterations and an estimate of the cost has been made. The plan proposes on the first floor, a large room 49 × 19 feet for meetings and social gatherings, an office or reception room, a room for the publications of the society, an

historical room, a fire-proof room for manuscripts and valuable documents, toilet room, etc.

On the second floor, a commodious, convenient and well-lighted double room for a general reading room, which is to be stocked with the current reviews, periodicals, magazines, newspapers and books of reference. A room for the Story Library, separate rooms for special libraries with tables and conveniences for readers and for consultation, and a fire-proof room for the collection of war relics; on the third floor, special library rooms, and shelving for books and printed matter which may be useful for reference, but would not be of such general interest as the libraries located in the second story. Attic and basement for duplicates and general storage purposes. Certain slight alterations are to be made in the house, besides building a new stairway, and the rendering fire-proof of certain rooms in the brick addition. The library and reading room should be neatly furnished, and so arranged as to be made attractive for members and others visiting them and the advantages to be gained by joining the society be such that an increased membership may be looked for.

It is estimated that the sum of fifteen thousand dollars will more than cover all the expense to be incurred, besides providing a sum sufficient to pay the running expenses for the next three years, and increasing the library by the purchase of new books, works of reference and works relating to history, science and art, and furnishing the reading rooms with a selection of the best reviews, magazines, weekly and daily papers, English and American, for the use of members.

The active coöperation of every member and friend of the Institute is needed at this time. In the building we have secured, or in fire-proof additions that in the future may be erected on land in the rear, might be gathered and preserved the records and relics of the old families, the

histories of cities and towns; in fact all that pertains to the old life and the new of the county; with a rallying centre so stable there would be a constant influx of books, manuscripts, works of art, etc., a collection which, with that already formed, would be of great value and interest to the whole community. The occupation of the new building will, undoubtedly, mark an important epoch in the history of the Society, and the necessary arrangements should be liberally provided for, with a careful and judicious consideration of the results in view.

Your committee would therefore recommend that the directors present this plan to the members at the annual meeting, at which time, a committee be appointed for the purpose of raising the money needed, and of carrying the plan into successful operation.

H. WHEATLAND,
Chairman.

Mr. HAGAR, in presenting the report, said that it was time that the Institute occupied its own building and this opportunity should not be allowed to pass unimproved. He hoped that the members of the Society would see that the plan was vigorously carried forward. Messrs. E. B. WILLSON, E. C. BOLLES, W. P. UPHAM, T. F. HUNT and F. W. PUTNAM spoke strongly in favor of the report, the general opinion being expressed that the recommendations contained in said report should be adopted.

Mr. F. W. PUTNAM, after stating that he was in full sympathy with the movement and should do all in his power to see it carried out, offered the following preamble and note.

Whereas in the alterations and improvements in the estate lately purchased by the Essex Institute contemplated by the report of the Directors just accepted, and in the carrying out of the plans therein outlined, the work of

this Society can be carried on to better advantage and its plans of usefulness extended

Voted, That the Directors of the Society are hereby fully authorized to make all necessary arrangements to carry into effect the plans proposed, and are hereby given full power to appoint committees outside of their own number for the purpose of raising funds or for any other special purpose connected with the project, which they shall deem expedient. This vote was unanimously passed.

Mr. Upham, in speaking favorably of the proposed plan, said that he had hoped that the Institute might find it expedient to open a part of its library, free to the public, and open the way for an Essex Institute Free Library which he sincerely hoped might come at no distant day, but possibly it was not the time for it now.

The meeting was strongly in favor of the plans proposed in the report of the Directors and of the vote offered by Mr. Putnam.

The plans of the proposed alterations in the Daland estate were shown, also an estimate of the probable expenditures.

THE RETROSPECT OF THE YEAR

compiled from the several reports read at the meeting, and the remarks of several members in relation thereto, presents the work of the Institute in its various departments since the last annual meeting.

Members. Changes occur in the list of our associates, by the addition of new names and the withdrawal of some by resignation, removal from the county or vicinity, or by death. We have received information of the death of the following members.

Solomon Varney, one of the oldest retired tanners and curriers of Salem, died May 24, 1885; a son of Solomon and Esther (Buxton) Varney, born in Salem, 20 Nov., 1814. In early life a tanner and currier, afterward for a time associated in the Boston Leather firm of Varney, Haskell & Co.; an active member of the Universalist society and highly esteemed. Elected to membership, Nov. 4, 1872.

Martha Goodhue Wheatland died at Salem, June 6, 1885; daughter of Benjamin and Mary Eddy (Bemis) Wheatland, born at Newmarket, N. H., March 12, 1828; removed to Salem in 1846. Elected to membership, Aug. 18, 1865.

Samuel Appleton Safford died at Fortress Monroe, Va., June 14, 1885; son of Samuel and Joanna (Appleton) Safford, born in Boston Jan. 1, 1813. Resided in Salem; for many years a member of the firm of E. Dodge & Co., flour merchants; was for several years commander of the Salem Light Infantry, a popular and much esteemed officer. After his removal from Salem he was a clerk in one of the departments in Washington, D. C. An original member.

Luke Brooks died in Salem, June 23, 1885; son of Timothy and Abigail (Mason) Brooks, born in Salem, Aug. 9, 1797; went to Eastport, April 1819; returned in April 1832 and engaged in the lumber business with his brother Samuel. In 1843 went into the Eastern commission business in Boston, continuing his residence in Salem. Elected to membership, Feb. 1, 1854.

Samuel Pickman Walcott died at his residence on La-

fayette Street, in South Salem, June 25, 1885; son of Samuel Baker and Martha (Pickman) Walcott, born in Hopkinton, Mass., Feb. 11, 1834. Elected to membership, May 9, 1866.

John Francis Tuckerman died suddenly of heart disease in Salem, on Saturday, June 27, 1885; son of Gustavus and Jane (Francis) Tuckerman, born in Boston, June 13, 1817; graduated Harvard Coll., 1837, and from the Medical School, 1841. In early life a surgeon in the U. S. Navy, afterwards in mercantile pursuits, and has been a resident of Salem for more than a generation. He possessed great musical taste and culture, and has been distinguished as a composer as well as a practical vocalist and an accomplished musician. Admitted to membership, July 6, 1864.

Charles M. Richardson died in Salem, July 2, 1885. He was son of Charles and Sarah (Mansfield) Richardson, born in Salem, 17 Jan., 1807; a pupil in the famous Master Archer's School. On the 11th of July, 1822, he entered the hardware store of William Dean, corner of Essex street and Derby square. In that locality his business was continued until his death, being interested in the successive firms, Wm. Dean & Co., Adams & Richardson, Richardson & Waters. He has held offices in the state legislature, the city government, and in various institutions, religious, charitable, etc. Elected to membership, April 6, 1853.

Augustus Timothy Brooks, a well-known and highly esteemed citizen, died on Tuesday evening, July 28, 1885. He was a son of Thomas and Mary (Richardson) Brooks;

born in Salem, Oct. 9, 1814; a member of the first class in the Salem English High School; left May 24, 1828, and entered the store of a relative, the late Isaac P. Foster. In a few years he established himself in the grocery and ship chandlery business on Derby street, gradually merging the latter into an extensive flour and grain, and coal business, remaining for half a century in the same neighborhood. He served in the common council several years and was one of the most prominent and active members of the Tabernacle Church and Sunday School. He was elected to membership, March 8, 1854.

James Silver Williams, one of our younger class of shipmasters, died at Salem, Aug. 1, 1885, after a brief illness. He was son of Charles F. and Sophia (Silver) Williams and was born at Salem, Oct. 1, 1843; after graduating from the High School, he went to sea and soon rose to the command of vessels in the Zanzibar and East African trade, owned by the late Capt. Bertram; during the late civil war, he entered the U. S. Navy as acting volunteer ensign; afterward agent for Capt. Bertram in the East; was several years U. S. consul at Aden, Arabia, whence he returned only a few months since. Admitted to membership, May 12, 1875.

Henry Kemble Oliver, originally Thomas Henry Oliver, died at his residence in Salem, on Wednesday, Aug. 12, 1885. He was son of Rev. Daniel and Elizabeth (Kemble) Oliver; was born at North Beverly, Nov. 24, 1800. He was fitted for college at the Boston Latin School and Phillips Academy; entered Harvard in 1814, remained there two years and then removed to Dartmouth college, entering the junior class in 1816, graduated 1818. He entered upon teaching in June, 1819, at the Salem Latin

School; on the establishment of the High School in 1827, he was appointed to the mastership and remained there three years. He then erected a building on Federal street, Salem, for an academy of which he was the instructor, until 1844, first for boys, afterwards for girls, when he was appointed by Gov. Briggs, Adjutant General of the state. In 1848, appointed agent of the Atlantic Mills, he removed to Lawrence where he continued twelve years, serving the city in various ways, especially on the school committee and as its mayor; in 1860 elected state treasurer; and then he returned to Salem. The constitutional term having expired, by invitation of Gov. Bullock, he visited the manufacturing districts, respecting the employment of children. In 1869, he was appointed by Gov. Claflin, chief of the Bureau of Labor and Statistics; he held this office four years. In the year 1876, a member of the Board of Judges at the Centennial Exhibition, Philadelphia; Mayor of Salem, 1877–8–9–80, retiring in 1881 from public life. He was many years a member of the examining committee of Harvard College and in 1846, secretary of Board of Visitors at U. S. Mil. Acad., West Point; lectured frequently on literary and educational subjects; composer of music, etc. Admitted to membership, July 6, 1864.

George Johnson Breed died at the Homœopathic Hospital, Boston, Aug. 12, 1885; son of Capt. Holten J. and Nancy (Symonds) Breed; born in Salem, January 7, 1827. In the decease of Mr. Breed, Salem loses one of its most accomplished musicians. That he was extremely modest and unambitious and hence unknown to many does not impair the statement that we have seldom had among us a more thorough pianist, a more brilliant performer, a

better teacher; yet his peculiar temperament led him to withdraw from society and exert his talents for the benefit of a few only. He was an excellent gentleman and had many warm friends and admirers. Admitted to membership, April 14, 1873.

Albert Gallatin Browne, a well-known citizen of Salem, died on Friday, Oct. 9, 1885, after a long illness. He was a son of James and Lydia (Vincent) Browne and was born in Salem, Dec. 8, 1805. In early life a cordage manufacturer, afterwards an agent of the Boston Hemp Co. In 1852 a member of the Executive Council. During the civil war, he held a government agency in the south, having the custody of the southern cotton. In late years he had retired from business. He was one of the early abolitionists and a friend of Garrison, Whittier and Sumner. Admitted to membership, Jan. 21, 1867.

Joseph Chisholm died on Saturday, Oct. 10, 1885. He was a son of William and Martha (Vincent) Chisholm, and was born in Salem, July 20, 1806. The father was a Scotchman of the ancient clan of Frazer, and the mother was a granddaughter of an Italian from Tuscany; a ropemaker by occupation, and was the clerk of the Naumkeag Fire Club from its organization, August, 1832. He was a person of extensive reading, and interested in the literary and religious institutions of the city. Admitted to membership, Nov. 10, 1852.

Charles T. Jenkins, a well-known citizen of Salem, died very suddenly of heart disease on Wednesday, Nov. 18, 1885, at the age of sixty-two. He was born in New York, June 18, 1827, and was the son of James and Susanna (Jordan) Jenkins. He came to Salem from California

about fifteen years since and married a daughter of the late Nathaniel Weston; a man of wealth, a director of the Naumkeag Street Railway Co., and a member of the Masonic Fraternity. Admitted to membership, Aug. 17, 1874.

David W. Bowdoin died at his home in Washington, D. C., on Tuesday, Dec. 1, 1885, at the age of sixty-nine years. The body was brought to Salem and buried in Harmony Grove cemetery, on the Thursday following. He was born in Braintree, Mass., came to Salem in early life and was a well-known photographer. About 1873 he removed to Kentucky, a few years after settled in Washington, D. C., following the occupation he pursued in Salem. He married Florence E., daughter of the late Gilbert Tapley of Danvers, who survives. Admitted to membership, Sept. 8, 1858.

Thorpe Fisher died in Salem, Dec. 9, 1885. He was the son of Moses and Louisa (Thorpe) Fisher, and was born at Francestown, N. H., April 24, 1804. He came to Salem in early life and was engaged in several occupations. In his declining years he was interested in the cultivation of his garden, contributing to the exhibitions of the Institute many specimens of choice fruits and flowers. An original member.

Rev. Sumner Ellis, D.D., died in Chicago, Ill., Jan. 26, 1886. He was born in North Orange, Franklin County, Mass., May 17, 1828. He was installed pastor of the Universalist society, Salem, Feb. 1, 1854, and closed a successful ministry, Sept. 1, 1858. The society flourished by his earnest labors. Admitted to membership, Jan. 8, 1858.

William Sluman Messervy, ex-mayor of Salem, died on Friday, Feb. 19, 1886, after a long and painful illness. He was a son of Capt. William Messervy, an old-time shipmaster in the East India and other trades. His maternal grandfather, Capt. William Sluman, for whom he was named, commanded a private-armed vessel in the Revolutionary war, and lost his life in the service. He was born in Salem, Aug. 26, 1812; after leaving school he went to Boston and served as clerk and book-keeper in several extensive establishments. In 1834 went to St. Louis, and found employment; in 1839 he engaged in the over-land trade to Mexico and went to Santa Fé. He spent seven years in Chihuahua and six in Santa Fé. Upon the organization of the territory of New Mexico he was elected delegate to Congress, and was at one time Secretary; during the absence of the Governor he became acting Governor. In 1854 he returned to Salem and in 1856–7 was the Mayor. After his return from Mexico he was engaged in attending to his own business affairs and as a director in one or more insurance offices and other corporations. He took an active interest in several of the literary and scientific institutions. Admitted to membership, Sept. 1, 1852.

Charles Roundy, the oldest of our old-time ship masters died at his residence, Salem, on Friday, Feb. 26, 1886. He was the son of Capt. Nehemiah and Rebecca (Boynton) Roundy, born in Beverly, Oct. 15, 1794. About 1804 the family removed to Salem. In 1809 he entered upon a seafaring life in the ship Augustus and continued in the merchant service always in the employ of Capt. Joseph Peabody one of Salem's most enterprising and distinguished merchants, until he left the sea in 1835. During the period of the war with England which

interrupted the commerce of the country, he enlisted in the Navy and served in the Frigate President, Commodore Rodgers and the Frigate Guerriere, Commodore Decatur, from which he was discharged in March, 1813. Upon leaving the sea, Capt. Roundy was interested as a merchant in many foreign voyages and other enterprises. Admitted to membership, June 9, 1864.

Abraham J. Stanley, a well-known musician, died in Salem, on Sunday, March 21, 1886. He was a son of Abraham and Thankful (Fish) Stanley and was born in Salem, Aug. 2, 1826. He had been connected with the Salem Brass Band for upwards of twenty-five or thirty years; a clarionet player; also a member of Gilmore's Band. Admitted to membership, July 14, 1864.

Jeremiah S. Perkins, long favorably known as superintendent of burials in Salem, died on Friday, March 12, 1886. He was the son of Aaron and Sarah (Staniford) Perkins, and was born in Ipswich, April 13, 1797. At the age of sixteen he came to Salem, and learned the tailors' trade and subsequently established himself in business, Mr. Samuel Chamberlain being his partner for five years; later he was associated with his brother Daniel, and afterwards took his son Jeremiah into partnership. In 1847 he was appointed superintendent of burials and continued in this office until his resignation in 1885. He was Captain of the Salem Mechanic Light Infantry from 1828 to 1834. Admitted to membership, July 6, 1864.

Francis Willoughby Pickman died at his residence in St. John, N. B., on the evening of March 21, 1886. He was the son of Benjamin and Anstiss (Derby) Pickman and was born in Salem, May 13, 1804. He generally resided in the Province of New Brunswick, occasionally in his native city. Admitted to membership, May 12, 1858

John James Babson, a prominent citizen of Gloucester, died on Tuesday, April 13, 1886. Born in Gloucester, June 15, 1809. He occupied many positions of trust. For many years cashier of the Gloucester Bank and for more than forty years a member of the school committee, being chairman for twenty-five years. Bank commissioner of Massachusetts in 1864 and 5, and member of both houses of the State Legislature. The historian of Gloucester and a trustee of the Sawyer Public Library; a member of Mass. Hist. Society and of the N. E. Hist. Gen. Society, and was in all an active worker. An original member.

Aaron Perkins died in Salem, on Wednesday, April 14, 1886. He was the son of Aaron and Sarah (Staniford) Perkins, and was born in Ipswich, June 16, 1799, and came to Salem when a youth. He learned the trade of a sailmaker, and afterwards by himself, and subsequently with William B. Brown, carried on an extensive clothing and furnishing business on Derby street. For many years, he was an active participant in the public affairs of his day, a director and afterwards President of the Mercantile National Bank. He was a member of both boards of the City Government and a Representative of the Massachusetts Legislature in 1846 and 1847, and an officer of various charitable and other institutions. Admitted to membership, April 16, 1866.

Meetings. Regular meetings were held on the first and third Monday evenings of each month. The following communications and lectures may be specified.

From *Edward S. Morse*, a familiar talk on "The Study of Natural History.

Chase Palmer, a lecture on "Combustion."

William D. Northend, on "The Bar and the Legal Proceedings in Essex County."[1]

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[1] See Hist. Coll., E. I, XXII, 161.

Frank R. Kimball, on the "Climatology of the United States."[2]

Frank Hamilton Cushing, a familiar talk on "Zuñi Folk-lore, or Myths and Stories of the Zuñis."

B. F. McDaniel, a lecture, "The First Steps in Geology."

Edwin C. Bolles, on the "Microscope and its Application."

John Ritchie, of Boston, a lecture with experiments and illustrations, on "The New Process of Wool-scouring lately invented by Charles Toppan."[3]

F. W. Putnam, on "Some Problems in American Archæology and their partial solution."

E. S. Morse, a paper on "Ancient and Modern Methods of Arrow Release."[4]

J. S. Kingsley, a familiar talk on "The Modern Methods of the Study of Natural History."

Howard Ayers, of Ann Arbor, Mich., on "The Carapax and Sternum of Decapod Crustacea."[5]

Stephen P. Hathaway, jr., of Marblehead, "The Second Congregational Church in Marblehead."[6]

George A. Perkins, "The Family of John Perkins of Ipswich, part II."[7]

James A. Emmerton, "Salem Baptisms."[8]

John H. Gould, of Topsfield, "Topsfield in the Revolution."[9]

FIELD MEETINGS. These have been held during the season, as follows: *First*, on Thursday, July 9, 1885, at Nantasket Beach in Boston Harbor. At 2.30 o'clock the afternoon session was held in the large parlors of "Hotel Nantasket." The President in his opening remarks alluded briefly to several meetings that had been held on the sea-

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[2] See Bulletin of E. I., XVIII, 15. [3]See Bulletin, XVIII, 1. [4]See Bulletin XVII, 145. [5]See Bulletin XVII, 49. [6] See Hist. Coll., XXII, 81. [7] See Hist. Coll., XXII, 103. [8] See Hist. Coll., XXII, 177. [7] See Hist. Coll., XXII, 297.

coast, in years past, especially to that on Salem Neck, June 22, 1880, to commemorate the two hundred and fiftieth anniversary of the landing of Winthrop in 1630. He also spoke of the previous arrivals at Salem: Conant in 1626, Endicott in 1628 and Higginson in 1629 and read extracts from the diary of Higginson under dates of June 26 and June 29, 1629, giving a very pleasing and flattering description of the harbor of Salem, its shores and its islands.

Mr. Henry Fitz Waters was introduced, and gave a very interesting account of his recent genealogical researches in London. He commenced by presenting his method of work, the difficulty experienced by those not possessed of special privileges in gaining access to the records, and alluded to some of the famous places where he sought for information. He spoke of himself as a gleaner gathering everything within his reach of value to America and especially to New England. Short descriptions were given of the Somerset House, where are kept the wills for a period of five hundred years, and of the British Museum with its vast fund of historical information, especially the valuable and interesting manuscripts, including the Maverick manuscripts and an old map of New England made in 1634 or 1635. Mr. Waters acknowledged the help he had received from antiquarian friends, and especially from James Russell Lowell, the U. S. Minister to England. He concluded by reading some extracts from curious old wills.

Prof. E. S. Morse said that, owing to the great heat, he was unable to take his anticipated stroll on the beach to collect specimens upon which to base his remarks; in lieu thereof he gave a short but very interesting description of the process of photo-engraving, showing several specimens of the work, and plaster casts, in illustration.

Second, at Salisbury Point, on Thursday, July 23, 1885. The party went by steam cars to Newburyport, and by horse-cars to the place of meeting. At Deer Island, Hon. Richard S. Spofford invited the party to alight and to accept his hospitality. His fine residence and extensive grounds were thrown open and an hour was most pleasantly passed. Again taking the cars, the party visited a curious formation of stones supposed by the residents in the vicinity to be of Indian build. These flat stones are placed in a circle, somewhat in the manner in which wells are built, the diameter of the circle about six or seven feet; shovels and hoes were put in use and more or less of the earth was removed from the inside, but nothing indicating that it was built or even used by the Indians was discovered. Mr. F. W. Putnam, who was of the party, expressed the opinion that the stones were placed by the white men at an early period, but for what purpose he could not say. Thence the party proceeded to River-side Hall where the afternoon session was held at 2.30 o'clock. The meeting was called to order by the President, who introduced *Rev. Anson Titus* of Amesbury, who made a short address of welcome. *Mr. Joseph Merrill* of Amesbury read an interesting account of "Golgotha" the oldest burying-ground in Salisbury; *Mr. Alfred Osgood* of Newburyport gave a humorous paper on the "Green-head Fly *Tabanus lineola*." *Mr. F. W. Putnam* of the Peabody Museum of American Archæology and Ethnology at Cambridge, spoke for an hour or more on the general subject of archæology and described several small collections of Indian implements which had been brought to the meeting for identification; all of these articles, arrowheads, gouges, sinkers, etc., were found in Amesbury or Salisbury. The speaker said that all these specimens belonging

to individuals should be brought together and a good local collection commenced, and such a collection should be confined to articles found in the immediate vicinity. He said that some of the specimens before him were remarkably fine and well worthy of very careful preservation. During his remarks he explained the methods of manufacture and the uses of the various implements exhibited.

Rev. B. F. McDaniel of Salem, being called upon, said "It seems fitting before we part that we give some expression to the feelings and thoughts that have been uppermost in our hearts and minds to-day. As we left our homes to assemble at this place, the tolling bells struck sadly on our ears, and we knew that the great soldier of the Union, whose patience, courage, and genius saved the Union to us in the time of its great need, had passed into the larger and higher life. Our hearts have been with him in his months of suffering, and now, as the inevitable end has come, we begin to realize what a loss has befallen our country. With the things we have seen and heard to-day to be added to our stores of mental riches, are mingled his image and deeds. I do not offer these remarks as a formal resolution, but as a simple expression in my own words of what is in all our minds and hearts."

Mr. Putnam answered several questions regarding the stone-work near the Chain Bridge. The Secretary offered a vote of thanks for the courtesies and favors extended to the members of the Institute and their friends during this pleasant visit to Salisbury Point, and the meeting then adjourned.

Third, Wednesday, Aug. 12, 1885, at Marblehead Neck. The afternoon session was held in the Hall of the Marblehead Neck Association at 2.30 o'clock. The President called the meeting to order and introduced *Mr. Julius A. Palmer* of Boston who spoke of mushrooms

and toadstools as food for man. The speaker said that without a pretence to a scientific knowledge of the subject he had devoted much time during the past ten years to the examination of these vegetables as articles of food. We neglect things of the greatest delicacy in ignoring mushrooms. Toadstools and mushrooms are, to a certain extent, synonymous terms, but the latter is in particular applied to the species (*Agaricus campestris*) most commonly cultivated and eaten. The little heads we get in cans and glass jars from France are of this species and are raised in the catacombs of Paris. Mr. Palmer spoke of many species not now in use, which are exceedingly palatable, and of some poisonous ones. He tested all species, the qualities of which are not already known, by first eating a bit; then, if not unpleasant, larger portions. Heroic tests are made only by the ignorant and foolhardy. The speaker answered several inquiries and related some anecdotes in relation to the subject. *Dr. J. S. Kingsley* was the next speaker and he gave an interesting account of the snails of our coast. He spoke chiefly of the true "periwinkle," an introduced mollusk, which has spread along our coast during the past twenty years so that it has become our most common species. This is edible, and in flavor is equal to the clam, and by many persons is preferred to that bivalve. *Mr. J. J. H. Gregory* of Marblehead followed, speaking of the rocks, particularly the porphyry and the uses made of the ledges of that rock on the Neck. *Mr. J. H. Sears* gave an account of the flora of the "Neck" and referred to many interesting plants. *Mr. John Robinson* made a few remarks on the mushrooms suggested by Mr. Palmer's statements, and offered a vote of thanks to the Marblehead Neck Association for the use of the Hall and to all others who had extended courtesies on this occasion.

LIBRARY.—The additions to the Library for the year (May, 1885 to May, 1886) have been as follows:

By Donation.

Folios	33
Quartos	92
Octavos	500
Duodecimos	250
Sixteenmos	90
Twenty-fourmos	33
Total of bound volumes	998
Pamphlets and serials	5,513
Total of donations	6,511

By Exchange.

Folios	7
Quartos	23
Octavos	163
Duodecimos	20
Sixteenmos	13
Twenty-fourmos	2
Total of bound volumes	228
Pamphlets and serials	2,833
Total of exchanges	3,061

By Purchase.

Quartos	28
Octavos	50
Duodecimos	37
Sixteenmos	12
Twenty-fourmos	5
Total of bound volumes	132
Pamphlets and serials	58
Total of purchases	190
Total of donations	6,511
Total of exchanges	3,061
Total of purchases	190
Total of additions	9,762

Of the total number of pamphlets and serials, 2,301 were pamphlets and 6,103 serials.

The above figures do not include the number of volumes contained in the library of the late Augustus Story, which was received in October last, from the estate of Miss E. A. Story; it comprised upwards of 1,000 vol-

umes and will be enumerated in the next annual report.

The donations to the Library for the year have been received from one hundred and forty-eight individuals and seventy-four societies and governmental departments. The exchanges from seven individuals and from one hundred and sixty-seven societies and incorporate institutions of which ninety-six are foreign; also from editors and publishers.

The annual examination of the Library has been made; of the sixteen volumes missing last year, twelve have been returned; nine others are now missing from their places.

Donations or exchanges have been received from the following:—

	Vols.	Pam.
Adelaide, So. Australia, Royal Society, ...		1
Allen, J. A., Cambridge, ...		1
Almy, James F., ...	1	14
Alnwick, Eng., Berwickshire Naturalists' Club, . . .		1
American Association for the Advancement of Science, Newspapers,	2	
American Ornithologists' Union, ...		4
Ames, George L , ...		2
Amherst College, Amherst, ...		104
Amiens, Société Linnéenne du Nord de la France, . .		16
Amsterdam, Société Royale de Zoologie Natura Artis Magistra, ...		1
Anagnos, M., So. Boston, ...		1
Andover, Phillips Academy, ...		1
Andover, Theological Seminary, ...		1
Andrews, William P., ...		45
Appleton, William S., Boston, ...		1
Archæological Institute of America, ...		1
Augsburg, Naturhistorischer Verein, ...		1
Baltimore, Maryland Historical Society, ...	1	3
Baltimore, Md., Johns Hopkins University, ...		21
Baltimore, Md., Peabody Institute, ...		1
Bancroft, C. F. P., Andover, ...		1
Barstow, Morey Hale, New York, N. Y., ...		1

Bartholomew, George W., Jr., Austin, Tex.,	1	
Batavia, K. Natuurkundige Vereeniging in Nederlandsch Indie,	2	1
Bayley, Miss E. S., Boston,		1
Beauchamp, Rev. W. M., Baldwinsville, N. Y.,		2
Bergen, Norway, Bergen Museum,	1	
Berkeley, Cal., University of California,		27
Berlin, Gesellschaft Naturforschende Freunde,		1
Berlin, Verein zur Beförderung des Gartenbaues,		52
Bern, Naturforschende Gesellschaft,		2
Blair, H. W., Washington, D. C.,	4	
Blanchard, Miss Sarah B.,	1	13
Bodge, Rev. George M., E. Boston,		1
Bolles, Rev. E. C., D.D.,	1	108
Bologna, R. Accademia delle Scienze,		1
Bonn, Naturhistorischer Verein,	1	3
Bordeaux, Société Linnéenne,	2	
Boston, American Academy of Arts and Sciences,	1	4
Boston, Appalachian Mountain Club,		3
Boston Board of Health,		14
Boston, Bostonian Society,		2
Boston, City of,	7	
Boston City Hospital,	1	
Boston, Massachusetts Historical Society,	9	514
Boston, Massachusetts Horticultural Society,		3
Boston, Massachusetts Medical Society,		1
Boston, Massachusetts State Board of Health,	1	
Boston, National Association of Wool Manufacturers,		3
Boston, New England Historic Genealogical Society,	1	10
Boston Public Library,		4
Boston Society of Natural History,		7
Boston, State Library of Massachusetts,		1
Bradlee, Rev. C. D., Boston,		1
Bradley, C. B., Berkeley, Cal.,		1
Bradley, C. S., Providence, R. I.,		1
Breed, Estate of the late George J.,	12	
Bremen, Naturwissenschaftlicher Verein,		2
Bristol, Eng., Naturalists' Society,		2
Brooklyn Library, Brooklyn, N. Y.,		3
Brooklyn, N. Y., Long Island Historical Society,		3
Brooks, Henry M.,	37	5
Brooks, Luke,	55	409
Brookville, Ind., Society of Natural History,		1
Brown, Henry A.,	5	126

Brunn, Naturforschender Verein,		3
Brunswick, Me., Bowdoin College,		1
Bruxelles, Académie Royal des Sciences, des Lettres et des Beaux Arts de Belgique,	6	
Bruxelles, Société Belge de Microscopie,	2	9
Bruxelles, Société Entomologique de Belgique,	2	
Bruxelles, Société Royale Malacologique,	3	23
Buenos Aires, Sociedad Cientifica Argentina,		9
Buffalo, N. Y., Historical Society,		1
Buffalo, N. Y., Society of Natural Science,		1
Buffalo, N. Y., Young Men's Association,		1
Burgess, George L., Portland, Me.,		1
Burley, Charles, Exeter, N. H.,		1
Burns, Charles,		2
Caen, Académie Nationale des Sciences, Arts et Belles Lettres,	2	
Calcutta, Geological Survey of India,		11
Cambridge, Harvard University,	1	2
Cambridge, Museum of Comparative Zoölogy,		6
Cannon, H. W., Washington, D. C.,	1	
Carpenter, Rev. C. C., Andover,	2	2
Case, Andrew,		10
Chadwick, James R., Boston,		5
Chamberlain, James,	7	89
Champaign, Ill., State Laboratory of Natural History,		1
Chapman, Miss M. R., Beverly,	1	29
Charleston, S. C., Elliott Society of Science and Art,		3
Cherbourg, Société Nationale des Sciences Naturelles,	1	1
Chicago, Ill., Historical Society,		4
Chicago, Ill., Public Library,		1
Christiania, Commission Géodésique de la Norvege,		2
Christiania, Videnskabs Selskabet,	1	
Cincinnati, O., Board of Education,	1	
Cincinnati, O , Public Library,	2	
Cincinnati, O., Society of Natural History,		4
Clarke, George K., Boston,	1	
Cleveland, O., Western Reserve Historical Society,		6
Cole, Mrs. N. D , ... Newspapers,		75
Conant, W. P., ... Newspapers,		
Concord, New Hampshire Historical Society,	1	
Cook, James P.,	1	
Copenhague, Société Botanique,		3
Crocker, Uriel H., Boston,	1	
Crowell, Rev. E. P., Amherst, ...Circulars,		

Curwen, James B., ...	12	34
Cutter, A. E., Charlestown, ...		1
Danzig, Naturforschende Gesellschaft, ...		1
Darmstadt, Verein für Erdkunde, ...	1	
Des Moines, Ia., Academy of Science, ...		1
Dodge, James H., Boston, ...	1	
Dow, Herbert B., Andover, N. H., ...		1
Dresden, Naturwissenschaftliche Gesellschaft "Isis," .		2
Dresden, Verein für Erdkunde, ...		1
Dublin, Royal Irish Academy, ...		8
Dublin, Royal Society, ...		5
Dunlap, Lauren, Huron, D. T., ...		9
Edes, H. H., Charlestown, ...		1
Ellery, Harrison, Boston, ... Circular,		
Emden, Naturforschende Gesellschaft, ...		1
Erfurt, Akademie Gemeinnütziger Verein, ...		1
Erlangen, Physikalisch-Medicinische Gesellschaft, . .		1
Essex Agricultural Society, ...		1
Exeter, N. H., Phillips Academy, ...		1
Falmouth, Eng., Royal Cornwall Polytechnic Society, .	1	
Florence, Italy, R. Biblioteca Nazionale Centrale, . .		8
Florence, Italy, R. Istituto di Studi Superiori, . .	2	1
Fogg, Miss Ellen M., ...	3	7
Forbes, R. B., Boston, ...	1	1
Forbes, S. A., Champaign, Ill., ...		1
Foster, Joseph, Philadelphia, Pa., ...		1
Frankfurt, A. M., Senckenbergische Naturforschende Gesellschaft, ...	2	
Freiburg, Naturforschende Gesellschaft, ...		1
French, A. D. Weld, Boston, ...	1	
Genève, L'Institut National Genèvois, ...	1	
Genève, Société de Physique et d'Histoire Naturelle, .		1
Glasgow, Natural History Society, ...		10
Gloucester, Evangelical Congregational Church, . .	1	
Göttingen, K. Gesellschaft der Wissenchaften, . . .	2	
Goodell, Mrs. A. C., jr., ... Newspapers,		16
Gould, John H., Topsfield, ...		2
Grant, Frederick, ...	1	
Granville, O., Dennison University, ...		1
Green, Samuel A., Boston, ...	63	629
Güstrow, Verein der Freunde der Naturgeschichte, . .	1	
Hale, Rev. E. E., Roxbury, ...		29
Halifax, N. S., Institute of Natural Science, . . .		1
Hamilton, Morris R., Trenton, N. J., ...	2	

Hamilton, R. I., Narragansett Historical Publishing Co.,		3
Hannover Naturhistorische Gesellschaft, ...		1
Harden, William, Savannah, Ga., ...		1
Harlem, Société Hollandaise des Sciences, . . .		6
Hartford, Conn., Trinity College, ...		2
Hill, B. D., ... Newspapers,		1
Hill, H. A., Boston, ...	8	
Hingham, Town of, ...	1	
Hixson, William D., Maysville, Ky., ...		2
Hobart Town, Government of Tasmania, . . .		1
Hobart Town, Royal Society of Tasmania, . . .		2
Holmes, John C., Detroit, Mich., . . . Circular,		
Horsford, E. N., Cambridge, ...		5
Hosmer, Rev. George H., ...	55	121
Hunt, T. F., ...	48	189
Iowa City, Ia., Historical Society, ...		6
Israel, Rev. F., ... Newspapers,	2	47
Kimball, Mrs. E. D., ...		1
Kimball, James P., Washington, D. C., ...	15	1
Kimball, William T., Lawrence, ...	1	
King, H. F., ...		1
Kinsman, Mrs. N., ...	85	2
Kjöbenhavn, K. D. Videnskabernes Selskab, . . .		4
Kjöbenhavn, Société R. des Antiquaires du Nord, . .		4
Königsberg, Physikalisch-Oekonomische Gesellschaft, .		2
Langworthy, Rev. I. P., Boston, ...		1
Lansing, Mich., State Agricultural College, . . .	1	10
Lansing, Mich., State Board of Agriculture, . . .	2	
Lansing, Mich., State Library, ...	29	3
Lausanne, Société Vaudoise, ...		1
Lawrence, Public Library, ...		1
Lee, F. H., ...	2	398
Leeds, Josiah W., Philadelphia, Pa., ...		1
Leeds, Eng., Philosophical and Literary Society, . .		1
Le Mans, Société d' Agriculture, Sciences et Arts de la Sarthe, ...		2
Liège, Société Royale des Sciences, ...	2	
Lincoln, Neb., State Historical Society, ...	1	
Liverpool, Eng., Literary and Philosophical Society, .	1	
London, Eng., Conchological Society, ...		4
London, Eng., Royal Society, ...		11
Lovett, Thomas D., Cincinnati, O., ...	1	
Lowell, Old Residents' Historical Association, . . .		1
Lund, Université Royale, ...	6	4

Luxembourg, Société Botanique, ...		1
Lyon, Académie des Sciences, Belles-Lettres et Arts, .	3	1
Madison, Wis., State Historical Society, . . .	1	2
Madrid, Observatorio, ...	10	
Madrid, Sociedad Española de Historia Natural, . .		2
Manchester, Rev. L. C., Lowell, ...		1
Manchester, Eng., Literary and Philosophical Society, .	1	2
Mannheim, Verein für Naturkunde, ...		1
Manning, Robert, ...		718
Manson, A. S., Boston, ...		1
Marietta College, Marietta, O., ...	1	1
Marshall, John W., Rockport, ...		1
Massachusetts, Commonwealth of, ...	4	1
Mayberry, S. P., Cape Elizabeth, Me., . Newspapers,		
McClurg, A. C., & Co., Chicago, Ill., ...	1	
McDaniel, Rev. B. F., ...	3	182
McLoud, Mrs. Anson, Newburyport, . . Newspapers,		
Meek, H. M., ...	2	
Merrill, William, jr., West Newbury, ...		23
Mexico, Museo Nacional, ...		2
Middlebury, Vt., Historical Society, ...		1
Milwaukee, Wis., Public Museum, ...		1
Minneapolis, Minn., Academy of Natural Sciences, . .		4
Mitchell, Donald G., New Haven, Conn., ...	1	
Montreal, Canada, Natural History Society, ...		5
Montreal, Canada, Société Historique, ...		1
Morse, E. S., ...	1	29
München, K. B. Akademie der Wissenschaften, . .	1	13
Münster, Westfälische Verein für Wissenschaft u. Kunst,		1
Nashville, Tennessee Historical Society, ...		1
Nashville, Tenn., State Board of Health, ...	1	
Nevins, W. S., ... Newspapers,		10
Newark, New Jersey Historical Society, ...	1	1
Newark, N. J., Library Association, ...		1
New Bedford, Public Library, ...		1
New Haven, Conn., Academy of Arts and Sciences, . .		1
New Haven, Conn., Yale College, ...	1	4
Newport, R. I., Natural History Society, ...		3
New York, N. Y., Academy of Sciences, ...	1	9
New York, N. Y., American Geographical Society, . .		2
New York, N. Y., Chamber of Commerce, ...	1	
New York, N. Y., Genealogical, Biographical Society, .		4
New York, N. Y., Historical Society, ...	2	

New York, N. Y., Huguenot Society of America, . .		1
New York, N. Y., Maimonides Library, ...		1
New York, N. Y., Mercantile Library Association, . .		3
New York, N. Y., Microscopical Society, ...		7
New York, N. Y., Union Defence Committee, . . .	1	
Nichols, Andrew, jr., Danvers, ...		6
Nichols, John H., So. Wilton, Conn., ...	12	3
Nolcini, C. A., ...		2
Northampton, Smith College, ...		1
Northend, William D., ...	3	77
Norwegian North Atlantic Expedition, ...		3
Nourse, Miss Dorcas C., ... Newspapers,		1
Nourse, Henry S., Lancaster, ...	2	50
Oliver, Henry K., ...	5	17
Oliver, H. K., Boston, ...		1
Osnabrück, Naturwissenschaftlicher Verein, ...	1	
Ottawa, Canada, Geological and Natural History Survey,	2	
Ottawa, Canada, L'Institut Canadien-Français, . .		6
Ottawa, Canada, Royal Society, ...	1	
Packard, A. S., Providence, R. I., ...		1
Palfray, Charles W., ... Newspapers,		399
Paris, Société d'Acclimatation, ...		15
Paris, Société d'Anthropologie, ...		5
Paris, Société des Etudes Historiques, ...	1	
Peabody, George L., ...	79	61
Peabody Institute, Peabody, ...		3
Peaslee, John B., Cincinnati, O., ...		2
Peet, Rev. S. D., Clinton, Wis., ...		6
Peirce, Henry B., Boston, ...	6	1
Perkins, A. T., Boston, ...		1
Philadelphia, Pa., Academy of Natural Sciences, . .		2
Philadelphia, Pa., American Philosophical Society, . .	1	3
Philadelphia, Pa., Historical Society, ...		6
Philadelphia, Pa., Indian Rights Association, . . .		1
Philadelphia, Pa., Library Company, ...		2
Philadelphia, Pa., Numismatic and Antiquarian Society, .		1
Philadelphia, Pa., Zoölogical Society, ...		1
Pickering, Miss Mary O., ...	22	
Pillsbury, Parker, Concord, N. H., ...		2
Plumer, Miss Mary N., ... Newspapers,		3
Pool, Wellington, Wenham, ...		2
Porter, Rev. Aaron, ...		1
Providence, Rhode Island Historical Society, . . .	20	10

Providence, R. I., New England Meteorological Society,		2
Providence, R. I., Public Library, ...		1
Putnam, F. W., Cambridge, ...	1	12
Putnam, H. W., ...	57	1
Rantoul, Robert S., ...	9	3
Regensburg, K. B. Botanische Gesellschaft, . . .	1	
Regensburg, Naturwissenschaftlicher Verein, . . .		1
Rice, Rev. C. B., Danvers Centre, ...		1
Richardson, Estate of the late Miss Eunice P., . . .	135	218
Riga, Naturforschender Verein, ...		1
Roberts, Miss M. L., ...		4
Robinson, John, ...	3	237
Russell, Mrs. Thomas B., ...		4
Safford, J. H., ... Newspapers,		
Salem, Peabody Academy of Science, ...	1	1
Salisbury, Edward E., New Haven, Conn., . . .	1	
Sampson, Murdock & Co., Boston, ...	1	
San Francisco, California Academy of Science, . .		1
San Francisco, Cal., Mercantile Library Association, .		1
Savannah, Georgia Historical Society, ...		1
Sedalia, Mo., Natural History Society, ...		1
Sewall, J. B., Braintree, ...		1
S'Gravenhage, Nederlandsche Entomologische Vereenig-ing, ...		4
Shanghai, China Branch of the Royal Asiatic Society, .	1	4
Sibley, Estate of the late John L., ...	3	
Smith, Miss Alice B., Hickman, Ky., . . Newspapers,		
Smith, George Plumer, Philadelphia, Pa., ...	1	
Smith, Miss Louise, Hickman, Ky., . . Newspapers,		
Snively, Rev. W. A., Brooklyn, N. Y., ...	1	
So. Boston, Massachusetts School for the Feeble-Minded,		1
Spinney, W. F., ...	1	12
Springfield, Illinois Department of Agriculture, . .		11
Stettin, Entomologischer Verein, ...	1	
St. Gallen, St. Gallische Naturwissenschaftlicher Verein,	2	
St. John, New Brunswick Natural History Society, . .		1
St. Louis, Mo., Public School Library, ...		1
Stockholm, K. S. Vetenskaps Akademien, ...	6	10
Stockholm, Société Entomologique, ...		2
Stone, Benjamin W., ...	3	1
Stone, Eben F., Washington, D. C., ...		127
Stone, Robert, ... Newspapers,		
St. Pétersbourg, Académie Impériale des Sciences, . .		3

St. Pétersbourg, Comité Geologique, ...		1
St. Pétersbourg Société Entomologique, ...	1	
Sutton, Estate of the late William, ...	34	
Sydney, Royal Society of New South Wales, . . .	1	
Taunton, Old Colony Historical Society, ...		2
Taunton, Public Library, ...		1
Taunton, Eng., Somersetshire Archæological and Natural History Society, ...	1	
Thacher, Peter, Boston, ...		1
Thompson, Waldo, Swampscott, ...	1	
Throndhjem, K. N. Videnskabernes Selskab, ...	1	
Tierney, P. F., ...	2	
Topeka, Kan., Academy of Science, ...		1
Topeka, Kan., Historical Society, . . Newspapers,		
Topeka, Kan., Natural History Department of Washburn College, ...		2
Topeka, Kan., Washburn College Laboratory, . . .		2
Toronto, Can., Canadian Institute, ...		2
Trenton, N. J., Natural History Society, ...		1
Tyler, Mrs. J. H., Winchester, ...		1
Unknown, ...	54	171
Upham, Rev. James, D.D., Chelsea, ...	1	
Upham, W. P., ...	1	
Upsal, Societas Scientiarum, ...		1
U. S. Bureau of Education, ...	1	5
U. S. Bureau of Ethnology, ...	1	
U. S. Chief of Engineers, ...	5	
U. S. Chief Signal Officer, ...	2	2
U. S. Civil Service Commission, ...		1
U. S. Coast and Geodetic Survey, ...	1	
U. S. Department of Agriculture, ...		3
U. S. Department of the Interior, ...	115	2
U. S. Department of State, ...	5	15
U. S. Fish Commission, ...	3	
U. S. Geological Survey, ...	6	17
U. S. Life Saving Service, ...	1	
U. S. National Museum, ...		42
U. S. Naval Observatory, ...	1	
U. S. Patent Office, ...	4	53
U. S. War Department, ...	6	
Verity, Mrs. J. S., Washington, D. C., ...	1	
Vilas, William F., Washington, D. C., ...	1	
Wagner, E. C., Philadelphia, Pa., ...		1

Ward, Rev. Joseph, Yankton, D. T., ...	1	
Waring, George E., jr., Providence, R. I., ...		1
Washington, D. C., Anthropological Society, . . .	1	
Washington, D. C., Legacion Mexicana, ...		1
Washington, D. C., Smithsonian Institution, . . .	6	
Waters, H. F., ...	1	
Waters, J. Linton, ...	9	39
Waterville, Me., Colby University, ...		1
Watson, Miss C. A., ...		61
Watson, S. M., Portland, Me., ...		5
Wheildon, William W., Concord, ...		1
Whelpley, A. W., Cincinnati, O., ...	10	
Whipple, George M., ...		11
Whitcher, Mary, Shaker Village, N. H., ...		12
Whitney, Mrs. H. M., Lawrence, . . Newspapers,		
Wicksteed, Rev. John, Ottawa, Can., ...		1
Wien, K. K. Naturhistorische Museum, ...		1
Wien, K. K. Zoologisch-Botanische Gesellschaft, . .	1	2
Wiesbaden, Verein für Naturkunde, ...		1
Wilkes-Barré, Pa., Wyoming Historical and Geological Society, ...	22	1
Willson, Rev. E. B., ...		12
Wilmington, Delaware Historical Society, . . .		1
Winnipeg, Can., Manitoba Historical and Scientific Society, ...		4
Winsor, Justin, Cambridge, ...		36
Winthrop, Robert C., Boston, ...	1	1
Winthrop, Robert C., jr., Boston, ...		2
Wisconsin, National Home for Disabled Soldiers, . .		1
Woburn Board of Trade, ...	1	
Woodbury, Charles Levi, Boston, ...	1	
Worcester, American Antiquarian Society, Newspapers,	1	3
Worcester, Society of Antiquity, ...	1	1
Würzburg, Physikalisch-Medicinische Gesellschaft, .	1	
Zurich, Naturforschende Gesellschaft, ...		14

The following have been received from editors or publishers:—

American Journal of Science.
Cape Ann Bulletin.
Chicago Journal of Commerce.
Danvers Mirror.
Fireside Favorite.
Gardener's Monthly and Horticulturist.
Groton Landmark.
Ipswich Chronicle.
Lawrence American.
Le Naturaliste Canadien.
Lynn Bee.
Manifesto, The.
Marblehead Messenger.

Musical Herald.
Musical Record.
Nation, The.
Naturalists' Leisure Hour and Monthly Bulletin.
Nature.
Our Dumb Animals.
Peabody Press.
Quaritch's Catalogue.
Sailor's Magazine and Seamen's Friend.
Salem Evening News.
Salem Evening Telegram.
Salem Gazette.
Salem Observer.
Salem Register.
Traveler's Record.
Turner's Public Spirit.
Voice, The.
Wade's Fibre and Fabric.
Zoologischer Anzeiger.

FINANCIAL.—The Treasurer's Report of the receipts and expenditures of the past year:

RECEIPTS.

Income of *General Account.*

Assessments of members,	$811 00	
Publications,	671 33	
Excursions, Use of Hall, etc.,	370 64	
Dividends N. Webster Bank,	17 50	
Return Tax,	4 34	
Portion of bills, Salem Athenæum,	178 62	
		2,053 43
Income, Historical fund,	12 00	
" Nat. History fund,	36 00	
" Davis fund and past income,	489 87	
" Ditmore fund,	140 00	
" Manuscript fund,	28 04	
" Ladies' Fair fund,	60 00	
" Derby fund,	18 00	
" Howes fund,	1,477 79	
" Story fund,	591 50	
" Peele fund,	101 00	
		2,954 20
Sale of securities to pay for		
Daland estate, $11,000 bonds =	12,742 00	
Salem Five Cents Saving Bank check,	1,000 00	
Salem Savings Bank check,	258 00	
		14,000 00
		$19,007 63

EXPENDITURES.

Balance last year, overdrawn		$117 52
Paid on *General Account.*		
Salaries,	1,920 00	
Publications,	937 43	
Fuel and Gas,	197 00	
Books, binding, printing and stationery,	639 30	
Repairs, expressage, postage and incidentals,	150 30	
Premium fire insurance,	61 25	
Salem Athenæum, as per agreement,	300 00	
Salem Athenæum, services of Librarian, etc.,	79 12	4,284 40
Paid Ditmore annuity,		110 00
Story annuity (ceased)		83 00
"Manuscript" account funded,		28 04
"Derby" account funded,		18 00
Paid for the Daland House, from the W. B. Howes fund,		14,000 00
Paid expenses thereon, insurance, coal and repairs,		254 34
		18,895 30
Balance on hand,		112 33
		$19,007 63
Amount of invested funds including real estate,		$48,896 63

Excursion to Niagara and Trenton Falls.—A party, consisting of members and friends of the Essex Institute, left Salem on Wednesday, June 10, 1885, by the Hoosac Tunnel route and the West Shore Line for Niagara Falls and spent two days in the examination of the principal points of interest in that locality. Thence went to Trenton and found a welcome retreat for Sunday's rest in Moore's Hotel, a quiet, good, old-fashioned English inn.

A large garden fronts the hotel and the most delightful of forests lies back of it, bordering the gorge for several miles; paths traverse it in various directions, affording frequent glimpses of the stream and the falls. What a haunt for the botanist with its many attractive plants, and

how fascinating to the geologist with the high, rocky walls, the leaves of the strata superimposed on each other as evenly as those of a book and crowded with fossils! Rev. B. F. McDaniel was of the party and pointed out the principal geological features and explained the fossil contents of the strata. Some good specimens were found.

Rev. William Silsbee, a native of Salem and a graduate of Harvard in the class of 1832, who has been for many years the revered and beloved pastor of one of the churches, extended a cordial welcome. He has a charming home; and the exterior of the fine stone building, that holds the Free Public Library, which he has gathered as one of the ripened sheaves of his work, was duly noticed.

The day following, the party proceeded to North Adams, and soon after arrival a large proportion of the tourists took carriages to Williamstown, only a few miles distant, the seat of Williams College, a most beautiful village, without fences on the street (hardly one in sight) ample lawns of the richest and closest verdure, overarching trees and wealth of shrubbery, a fine and striking illustration of the influence of the village improvement societies that have been organized in many of the rural villages of the New England states. The next day, Tuesday, left North Adams in the morning and arrived at Salem the same afternoon.

In this short week, many new pictures have been hung in Memory's halls and through them will echo the sweet music of Trenton and the mighty tones of Niagara.

The Rose Show, on Thursday, June 25, 1885, was well attended, and there was a fine collection. Among the contributors were Hon. J. B. F. Osgood, Mrs. Benj. Creamer, Miss E. Ropes, Mr. Charles Bowker, Mr. John H. Punchard, Miss Carrie Read, Mrs. C. H. Miller, E.

Putnam, Miss Lottie Chase, Mrs. John West, Jesse B. Edwards, George D. Phippen, Mrs. S. J. Peck, R. B. Gifford, jr., S. P. Fowler, George Russell, H. W. Putnam, Wm. J. Foster, Mrs. N. B. Mansfield, W. S. Ward, Frederick Lamson.

Mr. John Robinson exhibited some curious Japanese and Siberian roses which were very pretty. There were also some handsome begonias, poppies and other flowers.

The committee on awards reported as follows: honorable mention, for best four blooms of roses, to Mrs. S. J. Peck; second best four to J. B. F. Osgood; best single bloom, to J. B. F. Osgood; second best single bloom, to Mrs. N. B. Mansfield; best twelve blooms, to J. B. F. Osgood; second best, to the same. Tea roses, best four blooms, to W. S. Ward; second, to F. Lamson.

Museum.—The specimens of natural history, including archæology, which have been given during the year, are on deposit with the Trustees of the Peabody Academy of Science, in accordance with previous arrangements. Those of an historical character, or that possess an artistic interest, have been arranged in the rooms.

The following may be specified as contributors: T. F. Hunt, Geo. L. Peabody, Ezra Brown, Israel R. Phelps, Mrs. Anna J. Haskell of Roxbury, Miss Ellen M. Fogg, Wm. McGrane, Mrs. Geo. F. Choate, John P. Peabody, Thos. D. Lovett, Cincinnati, O., J. Linton Waters, John Robinson, Peabody Academy of Science, Jos. S. Carels, Nashville, Tenn., estate of Miss E. P. Richardson, Mrs. Wm. Sutton, B. D. Hill, J. W. Dunphy, Boston, Capt. Henry F. King, John H. Nichols, So. Wilton, Conn., Mrs. Morrill Ricker, J. W. Moulton, Wm. D. Northend, Mrs. Edmund Upton, Miss Mary R. Kimball, S. B. Buttrick, Samuel A. Green, Boston, Mrs. Jas. Kimball, R. S.

Rantoul, Miss Sarah B. Blanchard, Dr. Charles Haddock, Beverly, Charles Pulsifer, Mrs. H. R. Cooke, New York.

The Secretary, in his report, says: "The most important society event of the year is the acquisition by purchase, of the estate adjoining Plummer Hall, known as the Daland estate. The report of the sub-committee, endorsed by the directors, will be read later, giving particulars of the purchase and information concerning the needs of the Institute in order that the new building may be fitted for occupancy. This report should receive the cordial support of every member of the society. Its recommendations, if carried out, will vastly strengthen the Institute and increase its usefulness; not only this, but members will personally find in the new building many advantages, privileges and comforts not possible in the years past."

The Secretary closes his report in the following words: "The society remembers with gratitude its members and many friends who have so cordially and so continuously supported it, and without whose aid it could not have lived; from its small beginnings in 1848 to the present time, its growth has been slow perhaps, but sure; and soon in a comfortable home of its own it hopes to show the valuable accumulation of books, pamphlets and historical articles, the work of years, properly arranged and in condition for use."

Dermatochelys Coriacea, Trunk Back or Leathery Turtle.

BY J. H. SEARS.

The preparation of the present paper was suggested by the capture, August 25, 1885, within the limits of Essex County, of a fine specimen of the leathery or trunk turtle which is now preserved in the collection of the Peabody Academy of Science.

This reptile is classed in the order Testudinata, section Sphargididea, genus Dermatochelys. There are two species: *D. coriacea*, inhabiting the tropical Atlantic and adjacent waters, and *D. schlegeli*, the tropical Pacific and Indian oceans. This classification is taken from Mr. Samuel Garman's Reptiles and Batrachians of North America, published in the Bulletin of the Essex Institute, Vol. XVI, 1884.

As early as 1554, this reptile was described by Rondeletus under the name of *Testudo coriacea mercurii.* In 1766, Linnæus figured and gave some account of this species in his Natural System, which he named *Testudo coriacea.* Blainville, in the Bulletin Société Philomatique in 1816, named the species *Dermatochelys coriacea*, as the name denotes, *Derma*, skin, *chelys*, turtle. To separate the species which have no shell from the Testudo or tortoises, Merrem, in his Amphibia, published in 1820, gave to this genus of sea turtles the name of *Sphargis* and applied the specific name *mercurilis* to the species under consideration. In 1829, Gravenhorst, in Okin Isis, gives a description of one of these reptiles to which he gave the name *Testudo tuberculata.* Wagler, in his system

Amphibia, 1830, called the species *Dermatochelys porcata*. In 1831, Gray in his synopsis of the animal kingdom classed this reptile as *Chelonium* (*Sphargis*) *coriacea*, and later, in the same year in his Cataphracta, he gives it the name of *Sphargis coriacea*. In 1836, Lesueur, in Cuvier's Animal Distribution, gives the name *Dermatochelys atlantica*. From this date until 1871 nearly all that has been recorded concerning this reptile has been under the name of *Sphargis coriacea*. In 1871, Dr. Albert Günther in the Zoölogical Record, Vol. VIII, mentions an example of Dermatochelys having the extreme dimensions of nine feet. This specimen was taken on the coast of New South Wales.

This reptile is recorded as having been taken on the coasts of France, England, Scotland, China, Japan, Africa and America, but its occurrence has been so rare that no accurate accounts of it have yet been published. According to Count Lacepède, a French naturalist, it was this species of turtle with which the Greeks were best acquainted, and he supposed it to have been particularly used in the formation of the ancient harp or lyre which was originally constructed by attaching strings or wires to the carapace of one of these marine reptiles. Rondeletus mentions that the ancients procured the turtle from Arcadia which is situated on the sandy shores of the Gulf of Arcadia, where these turtles lay their eggs, but Cuvier and other modern writers discredit this statement, as it is said that the turtle used was procured from the groves or woods of Arcadia, also that the back of this turtle with its seven sharp ridges was likened to a harp with the strings attached which gave it the name of Luth. It is said that the flesh is coarse and offensive, but that the Carthusian monks will eat no other turtle. In the Encyclopedia Brittanica I find the following ac-

count of a leathery or trunk turtle: "In the month of August, 1729, three leagues from Nantes near the mouth of the Loire one of these marine reptiles was taken which measured seven feet and is said to have uttered a scream so loud as to have been heard a mile." Dr. D. Humphreys Storer, in his Report upon the Reptiles of Massachusetts, says, "The naturalist may judge of the great rarity of this species from the following observations by Dumeril and Bibron in their Erpetologie générale ou Histoire complete des Reptiles. This species is very rare. It inhabits the Mediterranean and the Atlantic ocean. Rondeletus mentions a *Sphargis luth* five cubits long which was taken at Frontignon. Amoreux describes another which was taken in the harbor of Cette, and Borlais gives a figure of a *Sphargis luth* that was taken in 1756 upon the coast of Cornwall, England."

In the Reptiles of Bermuda, by Samuel Garman, Bulletin No. 25, U. S. National Museum, I find the following notice in regard to the ovulation of Sphargis. The items are copied from the Morning Journal of April 30, 1846, by Gosse, in the Naturalist's Sojourn in Jamaica, 1859, p. 350, and bears the marks of its origin in evidence of desire to make the most of it, yet as Mr. Gosse remarks, it has sufficient appearance of accuracy to warrant preservation. The locality of the occurrence is Negril Bay at the west end of Jamaica. "The anxiety of the fishermen in this little village was aroused on the thirtieth of last month by the track of a huge sea monster called a trunk turtle which came on the sea beach for the purpose of laying her eggs; a search was made when a hole was discovered about four feet deep and as wide as the mouth of a half barrel, whence five or six dozen white eggs were taken; the eggs were of different sizes, the largest being the size of a duck's egg. On the morning of the tenth of this

month at half-past five o'clock she was discovered by Mr. Crow on the beach near the spot where she first came up; he gave the alarm when all the neighbors assembled and got her turned on her back. It took twelve men to haul her 200 yards. I went and measured her and found the dimensions as follows: from head to tail 6 feet 6 inches, from the outer part of her fore fin to the tip of the other 9 feet 2 inches, around her neck 3 feet 3 inches, widest part of fore fin 18 inches, the hind fins 2 feet 4 inches. Her back is formed like the round top of a trunk with small white bumps in straight lines resembling the nails on a trunk; her color is variegated like the rainbow. There is no shell on her back but a thick skin like pump leather. The date would place the laying time in the latter part of March instead of as early claimed by the fishermen and turtlers, December, January and February, for this genus. Sphargis is the most rare and least known of the sea turtles."

Dr. D. Humphreys Storer in his report of the Reptiles of Massachusetts, published in 1839, has the following: "*Sphargis coriacea.* The first one taken on the coast of the United States was found on the surface of the water in Massachusetts Bay in 1824 and brought to Boston where it was purchased by Mr. Greenwood of the New England Museum of its captors for two hundred dollars." In the summer of 1852 or 1853 one was washed on the shore at Nahant, and one was captured on the coast of Maine in July, 1866, from which specimen Prof. E. S. Morse made a sketch. The one now in the cabinet of the Boston Society of Natural History was taken at Annisquam in 1880. Mr. Winchester Smith of Salem in September, 1882, bought one of these turtles from some fishermen in Gloucester; it was caught some distance from that port and was purchased of Smith and Parker of Salem in 1884,

by the Peabody Academy of Science. Another one was taken in Portland harbor July 22, 1885, and on the twenty-fifth of August, 1885, Mr. Parsons of Rockport caught a fine specimen of the leathery or trunk-back turtle alive. This turtle was found entangled and completely wound up in a mackerel net which was set in the cove between the Salt Rocks and Milk Island opposite Long Beach, Rockport. It was towed to shore on Long Beach, where it required the efforts of eight men to load it on a wagon; it was carried to Pigeon Cove from which place Mr. Parsons sent a telegram to the Peabody Academy of Science announcing that he had a new species of turtle. On going to Pigeon Cove the next morning, I found he had caught a superb specimen of the leathery or trunk-back turtle. This specimen measured 7 feet, 3 inches from his nose to the end of his tail, 5 feet across the back in the widest part; his anterior flippers or arms were 3 feet long and 16 inches across in the widest part; the posterior flippers were 22 inches long and 20 inches wide. The skin on his back and upper portions of the body was a peculiar greenish brown color not unlike dried fucus. The sides and upper parts were a creamy white blotched with a bluish black. The motions of this turtle were remarkably quick for so large a creature when out of its natural element; it moved around the room in which it was confined, upsetting barrels, tables and the stove as easily and as quickly as a Texas wild steer would have done, causing a general commotion. In its struggles while being secured (which was accomplished by lashing the anterior flippers together on the under side) it uttered a sound of great volume, an indescribable kind of noise such as is heard sometimes at a menagerie. Its eyelids open vertically or in the opposite direction to that of other turtles. Unlike other turtles, this species cannot

turn their head sidewise or move it up or down, so that we were perfectly safe from his vicious snaps while securing his flippers.

This turtle lived two and one-half days in captivity, and on the twenty-eighth of August was purchased by the Peabody Academy of Science. Before his preparation for the Museum I made a partial examination of his internal structure. Each lobe of the brain measured eleven and one-half inches in longitudinal circumference and nine and three-quarters inches transversely; the whole brain weighed seventeen ounces. From its close convolutions and weight I considered that it would be a high order of development. This is unlike other species of turtles, as they are all described as having a small brain and of a lower order of development. The base of the tongue, roof of the mouth and the whole inside of the digestive canal was lined with a series of long, sharp, pointed spines. In the mouth, throat and œsophagus they were of a hard, horny substance throughout. In the stomach cavity these spines were one-third of an inch in diameter and two and one-half inches long, of a cartilaginous nature with hard, sharp points, all of which pointed downwards. The entire digestive canal with its lining of spines has been preserved for future study. The widest part was eight inches across and four feet six inches long. Before this canal was cut open it was quite rigid, being completely filled with these spines which would seem to prevent anything of a large size from being swallowed, and as the turtles have no teeth they are obliged to swallow their food whole or in such parts as they can bite off with their beak-like jaws. To whatever use in the digestive economy these spines are adapted I shall not attempt to consider, but they led Mr. Garman to remark that it was an excellent provision for rapid

digestion. In Dr. Storer's Report of the Reptiles of Massachusetts, published in 1839, I find the following in regard to these spines: "Upon the middle and posterior portions of the roof of the mouth are strong spinous processes and a portion of the œsophagus is in the cabinet of the Boston Society of Natural History; it is completely armed with long, firm and very sharp spines." In the digestive canal I found quite a number of Amphipod crustaceans of the genus Hyperia, identified by Doctor Faxon of the Museum of Comparative Zoölogy. The species is unknown. These little crustaceans are often found attached to the under side of the larger jelly fishes and it is possible that the jelly fish forms a portion of the food of this reptile, though in the stomach there were found some pieces of what appeared to be loligo partially digested. In Wood's Natural History I find the following: "The Leather turtle feeds upon fish, crustacea, mollusks, radiates and other animals." In the smaller intestines there was found a kind of whitish mucus and curiously enough a piece of bark about two inches in diameter. The gall-bladder was quite large, holding I should think about a quart of very dark green matter. The lungs were over two feet in diameter, transversely, and eighteen inches in length; they were traversed by air tubes a quarter of an inch in diameter. The heart was about the size of an ox and not unlike it in general shape. Just inside the skin was a lining of a cartilaginous substance from one-half to one inch thick on the sides and back; when this was cut into, a clear, yellow oil would run out, but upon coming into the air would soon congeal to a granular mass resembling cosmaline. The skin on the under side was about a quarter of an inch thick resembling coarse sole leather. The turtle proved to be a male and weighed 750 pounds. When found in the net there was a large specimen of the

pilot fish under his flipper which I procured from Mr. Parsons, and it is now in the collection of the Peabody Academy of Science. As this specimen of the Dermatochelys is the third one taken on the coast of Essex County, it may be recorded as one of the Testudinata of this county. This is in accordance with the recorded list of birds, fishes, etc., in the county collection, as many species of birds that are recorded as county specimens are only occasional visitors, or rest here during their migrations to the north in the breeding season.

I append a list of the Testudinata of Essex County, as represented in the cabinet of the Museum of the Peabody Academy of Science, as follows:

TESTUDINATA OF ESSEX COUNTY.

Sphargididæ.
- Dermatochelys coriacea *Blainville.*
- Trunk Back or Leathery Turtle.

Chelydroidæ.
- Chelydra serpentina *Schweigg.*
- Snapping Turtle.

Cinosternoidæ.
- Aromochelys odorata *Gray.*
- Stink-pot or Musk Turtle.

Emydoidæ.
- Chrysemys picta *Gray.* Painted Turtle.
- Cistudo carinata *Flem.* Box Turtle.
- Nanemys guttata *Ag.* Spotted Turtle.
- Emys melagris *Brongn.* Blanding's Tortoise.
- Glyptemys insculpta *Ag.* Wood Tortoise.

List of native and introduced plants observed in flower in the vicinity of Salem, during the spring of 1886, on or before May 1.

BY J. H. SEARS.

Symplocarpus fœtidus, *Salisb.* Skunk Cabbage.
Draba verna, *Linn.* Whitlow Grass.
Anemone hepatica, *Linn.* Liver Leaf.
Erythronium Americanum, *Smith.* Dog's-tooth Violet.
Oakesia sessilifolia, *Watson.* Bellwort.
Trillium erectum, *Linn* Purple Trillium.
Nepeta Glechoma, *Linn.* Ground Ivy.
Taraxacum Dens-leonis, *Desf.* Dandelion.
Antennaria plantaginifolia, *Hook.* Everlasting.
Tussilago Farfara, *Linn.* Coltsfoot.
Houstonia cærulea, *Linn.* Bluets.
Aralia trifolia, *Gray.* Dwarf-Ginseng.
Chrysosplenium Americanum, *Schwein.* Golden Saxifrage.
Saxifraga Virginiensis, *Michx.* Early Saxifrage.
Ribes hirtellum, *Michx.* Gooseberry.
Potentilla Canadensis, *Linn.* Common Cinquefoil.
Fragaria vesca, *Linn.* Strawberry.
Cerastium arvense, *Linn.* Field Chickweed.
Stellaria media, *Smith.* Common Chickweed.
Viola sagittata, *Ait.* Arrow-leaved Violet.
Viola pubescens, *Ait.* Yellow Violet.
Capsella Bursa-pastoris, *Moench.* Shepherd's Purse.
Sanguinaria Canadensis, *Linn.* Blood-root.
Aquilegia Canadensis, *Linn.* Columbine.
Caltha palustris, *Linn.* Marsh Marigold.
Thalictrum Anemonoides, *Michx.* Rue Anemone.
Anemone nemorosa, *Linn.* Wind-flower.
Medicago lupulina. Black Medick.
Thalictrum dioicum, *Linn.* Early Meadow Rue.
Ranunculus abortivus, *Linn.* Small-flowered Crowfoot.
Callitriche verna, *Linn.* Water Starwort.
Viola lanceolata, *Linn.* Lance-leaved Violet.
Viola blanda, *Willd.* Sweet White Violet.
Actea spicata, var. rubra, *Michx.* Red Baneberry.
Senecio vulgaris, *Linn.* Common Groundsel.

Introduced Garden Plants.

Pachysandra procumbens, *Michx.* Pachysandra.
Trillium sessile. Dark-flowering Trillium.
Trillium grandiflorum, *Salisb.* Large White Trillium.
Trillium erythrocarpum, *Michx.* Painted Trillium.
Ranunculus ficaria, *Linn.* Pilewort.
Narcissus jonquilla. Jonquil.
Narcissus pseudo-Narcissus. Daffodil.
Galanthus nivalis. Snowdrop.
Crocus vernus. Spring Crocus.
Tulipa suaveolens. Sweet Tulip.
Tulipa Gesneriana. Common Tulip.
Scilla verna. Squill.
Hyacinthus orientalis. Hyacinth.
Muscaria Botryoides, *Mill.* Grape Hyacinth.
Vinca minor. Common Periwinkle.
Uvularia grandiflora, *Smith.* Large-flowered Bellwort.
Tiarella cordifolia, *Linn.* False Mitre-wort.
Claytonia Virginica, *Linn.* Spring Beauty.
Viola Tricola, *Linn.* Heart's-ease.
Viola odorata, *Linn.* Sweet Violet.
Primula sinensis. Chinese Primrose.
Primula officinalis. English Cowslip.
Primula grandiflora. True Primrose.
Dodecatheon Meadia. Dodecatheon.
Buxus sempervirens. Box.
Lamium amplexicaule. Dead Nettle.
Phlox subulata. Ground or Moss Pink.
Mertensia Virginica. Lung Wort.
Fritillaria melargris. Guinea Hen Flower.
Iberis sempervirens. Evergreen Candytuft.
Iberis montana. Common Candytuft.
Phlox setacea. Neuroloma.
Phlox nivalis. White Neuroloma.
Corydalis nobelis. Large-flowered Corydalis.
Tulipa sylvestris. Scotch Tulip.
Saxifraga crassifolia. Thick-leaved Saxifrage.
Dicentra spectabilis. Bleeding Heart.
Helleborus nigra, *Linn.* Black Hellebore.
Trollius laxus, *Salisb.* American Globeflower.
Adonis vernalis, Spring Adonis.
Anemone Hortensis, Star Anemone.
Uvularia perfoliata, *Linn.* Perfoliate Bellwort.
Polygonatum giganteum, *Dietrich.* Great Solomon's Seal.

Fritilaria Imperialis. Crown Imperial.
Lunaria bienis. Honesty.
Lamium album, *Linn.* White Dead Nettle.
Lamium maculatum, *Linn.* Spotted-leaved Dead Nettle.
Corydalis aurea. Golden Corydalis.
Dicentra eximia. Dutchman's Breeches.
Eranthis hiemalis. Winter Aconite.
Alyssum Saxtile. Rock Alyssum.
Epimedium alpinum. Barren Wort.
Epimedium macranthum. Large-flowered Barren Wort.

Native Grasses, Sedges, etc.

Poa annua, *Linn.* Low Spear Grass.
Carex præcox, *Jacq.* European Sedge.
Carex vulgaris, *Fries.* Sedge.
Carex Pennsylvanica, *Linn.* Wood Sedge.
Luzula campestris, D C. Wood Rush.
Equisetum arvense, *Linn.* Common Horsetail.

Native Trees and Shrubs.

Acer dasycarpum, *Ehrhart.* White or Silver Maple.
Acer rubrum, *Linn.* Red or Swamp Maple.
Acer saccharinum, *Wang.* Sugar or Rock Maple.
Acer platanoides, *Linn.* Norway Maple.
Salix discolor, *Muhl.* Glaucous-leaved Willow.
Salix humilis, *Marshall.* Prairie Willow.
Salix cordata, *Muhl.* Heart-leaved Willow.
Salix petiolaris, *Smith.* Petioled Willow.
Salix viminalis, *Linn.* Basket Willow.
Salix livida, *Wahl.* var. occidentalis. Livid Willow.
Salix alba, *Linn.* White Willow.
Ulmus Americana, *Linn.* White Elm.
Ulmus campestris, *Linn.* English Elm.
Alnus incana, *Willd.* Hoary Alder.
Alnus serrulata, *Ait.* Smooth Alder.
Populus tremuloides, *Michx.* American Aspen.
Populus grandidentata, *Michx.* Large-toothed Aspen.
Populus balsamifera, *Linn.* var. candicans. Balm of Gilead.
Populus alba, *Linn.* White Poplar.
Corylus Americana, *Walt.* Wild Hazel-nut.
Corylus rostrata, *Ait.* Beaked Hazel-nut.
Ostrya Virginica, *Willd.* Hop Hornbeam.
Carpinus Americana, *Michx.* American Hornbeam.
Taxus baccata, *Linn.* American Yew.

Juniperus Virginiana, *Linn.* Red Cedar.
Juniperus communis, *Linn.* Juniper.
Lindera Benzoin, *Meisner.* Spice Bush.
Cassandra calyculata. Leather-leaf.
Epigea repens, *Linn.* Trailing Arbutus.
Vaccinium Pennsylvanicum, *Lam.* Dwarf Blueberry.
Amelanchier Canadensis, *Torr.* Shad Bush.
Comptonia asplenifolia, *Ait.* Sweet Fern.
Myrica Gale, *Linn.* Sweet Gale.
Betula lutea, *Michx.* Yellow Birch.
Betula alba, L., var. populifolia, *Spach.* American White Birch.
Fraxinus Americana, *Linn.* White Ash.
Fraxinus sambucifolia, *Lam.* Black Ash.
Ribes aureum, *Pursh.* Missouri Currant.
Ribes rubrum, *Linn.* Red Currant.
Prunus Cerasus. Cherry.
Prunus Persica. Peach.
Amygdalus nana. Flowering Almond.
Zanthorhiza apiifolia, *L'Her.* Shrub Yellow-root.
Pyrus communis. Pear.
Forsythia viridessima. Forsythia.
Forsythia suspensa. Slender Forsythia.
Forsythia Fortunii. Forsythia.
Salix caprea. European Willow.
Salix kilmarnock. Kilmarnock Willow.
Dirca palustris, *Linn.* Leather-wood.
Magnolia conspicua. Yulan of the Chinecs.
Spiræa prunifolia. Bridal Wreath.
Larix Europea, *Linn.* European Larch.
Prunus domestica. Garden Plum.
Daphne Cneorum. Garden Daphne.
Magnolia soulangeana. Hybrid Magnolia.
Negundo aceroides, *Maench.* Box-leaved Elder.
Shepherdia argentea, *Nutt.* Buffalo-berry.
Pyrus malus, *Linn.* Apple Tree.

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THE DEVELOPMENT OF CRANGON VULGARIS.

SECOND PAPER.[1]

(With Plates I and II.)

BY J. S. KINGSLEY, SC. D.

THE observations here recorded were made at Salem, Mass., during the summers of 1885 and 1886. I have here to return my thanks to Dr. Henry Wheatland, Mr. George D. Phippen and the Naumkeag Street Railway for many facilities afforded me. The literature of crustacean embryology has become so enormous that any résumé of the work of previous writers, even on the limited group of decapods, is next to impossible. I have, however, endeavored to give proper credit in the text for all work done by other embryologists, while appended is a bibliography of the papers quoted. Full titles are given of only those papers which are not mentioned in Faxon's valuable bibliography (**'82**).

[1] The first paper of the series is upon the development of the compound eye and appears in the first number of Whitman's "Journal of Morphology."

Several authors have investigated the development of Crangon, and an enumeration of their names may not be out of place here in order that the present paper may have an historical completeness.

Rathke ('36 and '37) was the first to study the development of the species,[2] but his account to-day possesses but little more than historic interest, though he describes the changes which occur within the egg. He compares it with Palæmon and Astacus, but failed to see the gastrula which is such a conspicuous feature in the latter genus, according to the accounts of all observers. Captain Du Cane describes and figures ('39, pl. vii, figs. 7 and 8) the newly hatched Crangon, while R. Q. Couch ('44) describes the same species as it escapes from the egg. Neither of these two papers has any present value. L. Agassiz makes a curious statement regarding this and some other genera. He says ('52) that Cuma is a larval form, the so-called different species being the young of Palæmon, Crangon and Hippolyte. This he claims to have proved beyond a doubt because he has raised them from the egg. A little later, C. Spence Bate showed that the Cumacea were adult, whereupon Agassiz reiterates ('56) his statement. Claus ('61) describes and figures a larva from Heligoland which he regards as the young of the present species. It is farther along in its development than any of the stages included in the present article. E. Van Beneden ('70, p. 142, pl. x, fig. 20) has some remarks upon the segmentation of the egg in this species which are quoted and criticised on a subsequent page of the present article. Smith ('73, p. 529) merely mentions

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[2] Rathke calls his form *Crangon maculosus*, but it is clearly but a color-variation of the widely distributed *Crangon vulgaris*.

the date at which the young appears in Vineyard Sound. Spence Bate (**'76**) states that in Crangon and several other genera of shrimps, "he has demonstrated that the three pairs of mobile appendages in the cirripedal or *Nauplius* form of larva homologize with the eyes and two pairs of antennæ, and not with the antennæ and mandibles, as stated by Fritz Müller, Anton Dohrn, and others." It is unnecessary to go into any detailed demonstration to show that nothing of the sort really occurs. Kingsley (**'86** and **'86a**) gives a brief account of the development of the compound eye in this genus.

METHODS.

I was not very successful in keeping my shrimps in confinement, owing, doubtless, to insufficient means of renewing the water. On this account I was obliged to depend for my material on fresh specimens caught almost daily, and to rely upon chance for the successive stages. Many attempts were made to obtain the parents before oviposition and to have them lay in confinement, but without success. I made some observations upon the ovarian egg, but they are not complete enough for publication.

For surface views I studied the fresh egg, and in the earlier stages I found it extremely useful to allow weak alcohol to run under the cover glass while the eggs were on the stage of the microscope. In this way parts before invisible are rendered distinct, and, at a certain stage of the process, the embryonic portions, when viewed by reflected light, are white upon a dark ground afforded by the yolk; by transmitted light, brown upon a translucent surface. This effect soon vanished, and all portions, when thoroughly impregnated with the alcohol, appeared alike. Stained specimens, viewed as opaque objects, were also of great value as may be seen from the plates.

Attempts to render the whole egg transparent and to mount it in balsam were not very successful.

For hardening, Perenyi's fluid, followed by successive strengths of alcohol in the usual manner, was found to be the best. For staining, Grenacher's alum-carmine gave the best results. Kleinenberg's hæmatoxylon and Grenacher's borax-carmine were also used with success. It was found impossible to remove the egg membranes, but the reagents mentioned penetrated fairly well. Except in studying the eye after the deposition of pigment had begun, the embryos were stained entire. The eggs were embedded in paraffin by means of chloroform; the sections were cut by the Thoma microtome and fastened to the slide with Schällibaum's collodion clove-oil mixture. I do not find it necessary, in using this, to heat the slide until the clove oil has evaporated, but merely enough to melt the paraffin and allow the sections to drop into the sticky film. The paraffin was then dissolved in turpentine and balsam and cover glass applied. The sections never became loosened. The processes involved in studying the eye are given elsewhere and need not be repeated here.

The small size of the eggs rendered it difficult to employ the ordinary method of orientation and so the following process was devised: The eggs (from thirty to fifty at a time) were placed in melted paraffin in a flat watch-crystal, and allowed to cool. Then, on looking *through the glass* with a hand-lens the exact position of each egg could be readily ascertained, and those suitable for sectioning could be cut out with a knife and mounted on the plug of the microtome in any desired position.

The drawings illustrating this paper were all made with the Oberhauser camera; in some the outlines being drawn by it and the details then filled in freehand, while in oth-

ers every nucleus was placed in the drawing with that instrument.

THE EGG.

The eggs are laid at Salem from the middle of June until the latter part of July. The method in which they are attached to the pleopoda calls for no special remark. They are placed in a single row in long, apparently structureless tubes which may frequently be untangled and straightened out, when they present a moniliform appearance. The eggs themselves vary slightly in size; some are nearly spherical but the majority are ovoidal and have a major axis of .024 and a minor one of .018 inch. As I have not been fortunate enough to see the oviposition, I cannot say whether, at the time of laying, the nucleus (apparently) disappears. In the earliest stage I have seen (Fig. 1), it was present, and the egg presented but slight difference from the later ovarian egg. The egg is enveloped in a very thin structureless envelope, inside of which I have found no traces of an inner or vitelline membrane, nor is there any space between the shell and the yolk. The protoplasm occupies a central position; it is not regular in outline, but gives off pseudopodal prolongations which ramify and pass between the yolk spherules in all directions. Whether these anastomose in their finer filaments or not, I am unable to say. I have not seen any such unions in the larger branches. The protoplasm is granular, the granules apparently taking a deeper stain than the rest, though this appearance may be due to a different refractive index. The nucleus is large and vacuolated, and in its interior is a well developed chromatin reticulum which traverses it in all directions, the fibres uniting on the wall of the nucleus in a thickened layer. Whether this reticulum is formed from one or from several filaments, my lenses and preparations

do not allow me to determine. I have seen no trace of any connection between the nuclear reticulum and the protoplasm of the egg. The yolk is granular, the yolk globules ranging considerably in size. The color of the fresh egg is a dirty-white.

SEGMENTATION.

The first and second segmentations of the egg take place before the so-called segmentation planes appear, and they are so similar in character that they may be described together. With the first segmentation the protoplasm begins to leave its central position and seek the surface of the egg; before the second division is completed it has reached the surface, leaving the yolk in the centre. In the process of cell division I have never seen any traces of karyokinesis; the division seems to be direct, and affects first the nucleus and next the protoplasm. Fig. 2 represents a section taken through the egg at the second segmentation, the plane passing through each of the resulting nuclei and the as yet unsevered protoplasm connecting the two potential cells. It exactly parallels, except in being nearer the surface, the phenomena of the first segmentation. The two nuclei have taken their places near the extremities of the elongate protoplasmic mass and each is vacuolated and provided with a chromatin reticulum. The protoplasm at either end shows the radial ramifying condition characteristic of the same material in the unsegmented ovum; but between the two nuclei extends a smooth cord, in the interior of which the granules present the appearance of longitudinal striæ. There is, besides, in this region an appearance as if the connecting band were double. As will be seen at either end, the protoplasm has reached the surface of the egg and surface views show that it there extends itself in the same stellate manner as was seen in

the unsegmented ovum. The character of the protoplasm and the yolk need but a word. The vacuoles in the former I attribute to the action of the reagents. In the latter the yolk globules have become largely confluent and have lost the spherical shapes which are seen in the fresh egg. The round marks are oil globules. The whole yolk stains faintly but I have not thought it necessary to represent it.

After the second protoplasmic segmentation is effected, the first segmentation furrows appear, the one following close upon the other. The first to appear corresponds in its direction to the first nuclear division, the second is at right angles to it. Though well marked when viewed from the surface, these furrows are in reality shallow grooves which affect but the superficial layers of the deutoplasm and which never have the depth of those occurring in many if not in most decapods (*e. g.*, Palæmon, Astacus, Eupagurus, Homarus, Cancer, etc.). In sections they show but as superficial constrictions; the mass of yolk never segments. That this is not the result of the hardening reagent (Perenyi's fluid) is shown by the fact that yolk segments do not appear in eggs hardened with alcohol alone. Still it does not follow that the segmented egg with unsegmented yolk is a syncitium. The nuclei and the surrounding protoplasm are completely separated and these are the essential portions of the cells; the yolk is secondary and adventitious and is to be regarded as occupying an extracellular position not only in Crangon but in many other cases, Balfour's remarks (**'80**, p. 98) to the contrary notwithstanding.

The general features of a decapod segmentation have been detailed so often (Haeckel, **'75**; Ishikawa, **'85**, Mayer, **'77**; Faxon **'79**; etc.) that it is not necessary here to follow it throughout in Crangon, which presents no

marked differences from other genera except in the direction already indicated. Figs. 3 and 4 are respectively surface and sectional views of a stage with about sixteen nuclei, and are introduced for the purpose of showing the external appearance and some of the points of internal structure. As will be seen from fig. 4, most of the protoplasm has reached the surface of the egg but there still remains some near the centre of the yolk. Whether this is the same as the protoplasm described by several authors (Reichenbach in Astacus, Ludwig in Spiders, '76) I cannot say; but I am certain not only that it is derived from the first segmentation nucleus, but also that it plays a part in the formation of the blastoderm. As this retardation of a portion of the cells in their journey to the surface seems to explain several points in the early stages of the arthropods, a moment may be given to it. While the cells which have reached the surface and which have thus formed a blastoderm are undergoing division, this central protoplasm also divides and gives rise to several cells which migrate, though much more slowly to the surface. In fig. 6 this migration is clearly shown, and it is to be noted that the cells are all proceeding in the same direction, apparently toward one side of the egg. This is shown in several of my sections, and not one indicates that these belated cells migrate to several portions of the surface.

This migration of the belated cells toward one point, together with a more rapid division of those in the same region which earlier reached the surface, results in the formation of the not very clearly delimited germinal area. Fig. 5 represents a section through the area shortly before the formation of the gastrula. In other parts of the egg, the nuclei are placed near the surface as at *b*, each surrounded with a scanty amount of protoplasm; but in the

germinal area, the protoplasm is far more abundant and forms a layer of considerable thickness (*ga*). In sections this has the appearance of a syncitium, as I am unable to discover any cell boundaries. In surface views, it is true, the cells here, as earlier, seem clearly marked off from each other; but as the figure shows, these lines of demarcation are but superficial and do not descend to any depth. This obliteration of cell walls here may be due to the action of Perenyi's fluid and I regret that this idea did not occur to me at the proper time to test it, so I cannot positively state that this region is really a syncitium. In the figure is represented, at c', one of the belated cells which has not yet joined its fellows; the complete series of sections of the egg show that it was the only one which remained behind. In surface views it is not easy to assign limits to the germinal area as it shades off insensibly into the surrounding undifferentiated blastoderm and is merely a portion of the surface where the protoplasm is more abundant and the nuclei more numerous than in other parts. In its general appearance it does not differ much at this stage from fig. 8, except that the blastopore shown in that figure is, of course, absent.

The variations in the character of the segmentation and the method of forming the gastrula and the germinal layers are so closely connected that a discussion of the segmentation of Crangon, as compared with that of other arthropods, is deferred until the end of the next section of the present paper; but here it is necessary to mention a conflict between my results and those of another observer.

Edouard van Beneden ['70, p. 142] says:— "Chez les Crangons, il se produit un fractionnement total du vitellus, comme chez les *Gammarus locusta*, et les cellules du blastoderme résultant de ce que dans chacun des segments, il s'opère en séparation compléte entre les éléments proto-

plasmiques et les éléments nutritives du vitellus." Though not referred to in the text, his figure 20 on plate X was apparently introduced to illustrate this point. It, however, does not do so, for it does not represent the central portion of the egg as divided, but can readily be interpreted to agree with the opinion here maintained. Van Beneden cut no sections, but depended on surface views for his results. Here I believe is the cause of our difference, for I can hardly regard it as the result of our having studied different species, since *Crangon vulgaris* is by far the most abundant Crangonid on the shores of Europe. In surface views the furrows of all crustacean segmentation seem deeper than they actually are and this I am confident led him into error. I may remark in passing that, to my mind, Van Beneden's statement (*l. c.*) that *Gammarus locusta* has a total, while a congeneric form has a partial, segmentation needs confirmation, as the point cannot be settled by surface observation. The illustrations given by Van Beneden of the segmented egg of *Gammarus locusta* certainly do not prove his point.

As to the presence or absence of karyokinesis in the segmentation and cell division of Crangon, my observations are not conclusive. I have not had the lenses necessary for a careful study of the subject, but even in the large nuclei of the earlier stages of segmentation as well as later in the large, rapidly-dividing, endodermal nuclei, I have not seen anything which I could interpret as relating in any way to karyokinesis, although the nuclear reticulum was clearly visible under my highest objective (Hartnack, viii). Under the circumstances, I am inclined to believe that the cell division is direct. Mayer in Eupagurus (**'77**) does not state whether a spindle metamorphosis of the nuclei occurred, but like myself he saw elongate nuclei and two nuclei in a cell. In fact, I do not recall a single statement

of karyokinesis being witnessed in decapod segmentation, excepting in Astacus (Reichenbach, '86); though it occurs in other Crustacean groups (*e. g.*, Cladocera, Copepoda, Grobben, '79 and '81). On account of the large size of the nuclei in the eggs of Cancer and Crangon they form especially favorable objects for studies in this direction.

THE GASTRULA AND GERM LAYERS.

Owing to the difficulties of following the changes of the cells in the living egg, I have been unable to follow out the phases of gastrulation as clearly as I could wish; but still my permanent preparations and my sections give a fair idea of the steps. Three of these are shown in figs. 7, 8, and 9. Of these the earlier is 8, which represents the invagination as already begun and is taken from an alum-carmine specimen, mounted entire. It shows the germinal area fading out on all sides into the general blastoderm while near the posterior margin of the area the blastopore is seen, the endodermal cells having already sunk beneath the surrounding surface. I am unable to say whether earlier these endoderm cells could have been recognized among the others of the germinal area; but I feel confident that there is no specialization of the mesodermal cells before the formation of the gastrula such as is described by Grobben ('79) in Moina and ('81') Cetochilus. Neither was there the shallow pit seen by Ishikawa in Atyephyra ('85, pp. 411–412) which is subsequently divided into two.

In the cells which surround the margin of the blastopore (fig. 8), the nuclei are mostly placed in the distal ends of the elongate cells, while in fig. 7, which represents a slightly later surface view, this feature of the circum-blastoporal cells is still further emphasized, the inner ends of the cells seeming to run down into the closing blastopore. What interpretation is to be placed on this I do not know.

The more prominent of the internal features of the gastrulation may be seen in fig. 9; which represents an oblique section through a stage intermediate between those shown in surface views. The endoderm cells (*h*) are being forced almost vertically into the yolk, though with an inclination towards the anterior end of the egg. The nuclei are placed at the deeper ends of the cells, the protoplasm of which stretches upwards to the blastopore. In the upper ends of these endoderm cells the boundaries between the cells can be seen with some distinctness as is shown in the figure, but deeper they entirely disappear. This invaginated endoderm is a solid mass and contains no lumen, or archenteron, and the blastopore itself is but a depression in the general surface of the egg. The subsequent fate of these cells will be traced later; but here we may say that they soon separate from the parent layer and sink into the yolk where they divide into two groups, a few going to the region where the stomadæum is subsequently to form, while the greater portion do not move far from the point of their differentiation and later unite with their fellows and with the proctodæum. These cells here, as in other species, form the mesenteron, the cavity of which exists, until after hatching, only in a potential condition, being filled completely with the deutoplasm. Through all of the larval stages these endodermal cells can be readily recognized by their larger size and by the fact that their nuclei stain less deeply than those of mesodermal or ectodermal origin.

Fig. 9 also shows some features in the origin of the third germinal layer, the mesoderm. On either side of the endodermal invagination may be seen some cells with large nuclei and amœboid outlines, which are plainly budding from the cells at the mouth of the blastopore and sinking into the yolk. Owing to the great difficulties encountered in orienting the eggs at this early stage, I cannot say that

I have fully satisfied myself as to the limits of the origin of the mesoderm. It certainly arises from both sides and from the anterior margin of the blastopore; whether it also has its origin from the posterior margin or not, I cannot positively say, though I am inclined to think that it does not. It certainly does not form there as abundantly as it does in front. Later, the mesoderm may be recognized by the fusiform cells with small nuclei crowded between the ectodermal structures and the yolk. It acquires its greatest development at first in the abdomen but appears only as a thin sheet in the cephalothoracic region until the embryo is nearly ready to hatch. I have at no time seen anything looking like 'mesenchyme' nor have I seen anything that could be interpreted as a budding of mesoderm cells from either ectoderm or endoderm. Neither do I see anyway, looking at Crangon alone, of deciding from which of the other germinal layers the mesoderm arises. It seems to come from the junction of the two.

Before the next stage becomes outlined the blastopore becomes completely closed. As a considerable time elapses between this closure and the formation of the stomodeal and proctodeal invagination it is a matter of considerable difficulty to say exactly what are the relations of the blastopore to either mouth or anus. As no appendages are as yet developed, there are no landmarks by which the position of the blastopore can be recognized in surface views and all that there is to guide one is the general outline of the rapidly changing germinal area. From this it would appear as if the anus arose either within or a very little in front of the position formerly occupied by the mouth of the gastrula; and I am inclined to the former view, since there is in the meantime a very rapid division and hence considerable extension of the circumblastoporal cells.

The relations of the mesoderm to the proctodæum would also seem confirmative of this view, for, as will appear later, most of it remains in the region where the anus is formed. The mouth appears to arise some distance in advance of the blastoporal region.

While the phenomena of gastrulation are well developed in most of the Crustacea, in the Hexapods and Acerata (Arachnids *plus* Limulus, Kingsley '85), they are so obscured as to have caused no little trouble for students. It seems to me that the facts detailed above for Crangon throw some light upon the other members of the group and show that the peculiar manner of origin of endoderm in the old group of 'Tracheates' is to be reconciled with the gastræa theory.

The great majority of the arthropods have a segmentation which is usually characterized as superficial (Haeckel, '75), or centrolecithal (Balfour, '80), both terms indicating that the segmentation is confined to the surface of the egg, while the centre is occupied by yolk which may, but which usually does not, segment. The term endolecithal, introduced by Claus, is synonymous with the earlier one of Balfour. Bruce ('86) is, as far as I am aware, the only one who has questioned this centrolecithal or superficial terminology. He says that the process in Thyridopteryx "can hardly be called a centrolecithal segmentation."

These terms (centrolecithal, endolecithal, superficial segmentation) seem unfortunate, for while there is a considerable similarity in the mode of segmentation of most arthropod eggs, in the earlier stages the yolk does not occupy a central position, nor is the segmentation superficial. As I have shown above, the egg nucleus, and presumably the segmentation nucleus, occupies, at first, at least in the egg of Crangon, a central position ; while, gathered around

it is the protoplasm of the egg, the whole being enveloped with the deutoplasm, a condition just the reverse of that implied by the terms endolecithal or centrolecithal. The first segmentation is confined to this central protoplasm, and it is not until the second segmentation is nearly completed (*vide* fig. 2) that any of the protoplasm reaches the surface; and for a long time afterward that which remains behind continues to undergo cell-division as well as that which has earlier reached the surface and has there begun to form the blastoderm. Hence at first, the segmentation is clearly not superficial.

The same state of affairs is recognizable throughout the whole of the series of so-called centrolecithal eggs, as can readily be seen by an examination of the results of all who have studied arthropodan segmentation by means of sections. It is even to be recognized in the results of many of the earlier workers. It is not necessary to give an exhaustive résumé of the work of previous students but a few may be instanced in support of this position.

In the Crustacea but few have carefully studied the phenomena of segmentation, and in some instances (Moina, Cetochilus, Lucifer) they throw but little light upon the present point. Haeckel's observations on the segmentation of Peneus (**'75**) seem at first sight to conflict with this view, for he represents the egg at the end of the second segmentation as divided into four segmentation spheres, in each of which is a nucleus, while the spheres are united at their inner surfaces in an undivided mass of yolk. The later stages present the same appearance. When we consider that Haeckel depended entirely on optical sections, an explanation readily suggests itself. He does not give the first segmentation, and if we regard his nuclei as really nuclei enveloped with protoplasm like those of Crangon, which are migrating toward the surface, the correspondence between the two is at once evident.

That we are justified in making these assumptions is shown by several things. First, Haeckel naturally took the bodies inside the lobes of the egg for nuclei alone, as at that time the structure of the cells was less understood than at present, and from what was known of other eggs, that seemed the only way to regard them. A comparison of Haeckel's figures with those of other students of Decapod segmentation shows that this explanation accords well with what is known of other forms. Thus Mayer ('77) describes, in the segmenting egg of Eupagurus, nuclei surrounded with a layer of protoplasm extending out, amœboid fashion, with the surrounding yolk. These must be regarded here, as in Crangon, as true cells, and their origin from the original nucleus and protoplasm must have been by segmentation in the centre of the egg. As in Crangon, they migrate to the surface and form a blastoderm enveloping an unsegmented mass of yolk. Faxon ('79), though he cut no sections, clearly shows that in Palæmonetes the same is the case. His figures 1 and 2 represent the nucleus surrounded in the same way with its protoplasm. Ishikawa ('85) apparently obtains the same result in Atyephyra, judging from his plates. His figures 35 and 36 are especially interesting in this connection, for they appear to substantiate the view here maintained, and when taken in connection with figures 38 and 39 clearly show that there is a migration of cells to the surface.

The extremely scanty observations on the segmentation of Limulus by Osborn ('85), and by Brooks and Bruce ('85) do not allow us to arrive at any very definite conclusions as to the character of the division, but the fact that, according to the last-mentioned authors, at the close of segmentation the entire yolk "consists of a uniform mass of large spherical yolk cells, each with its nucleus," would seem to indicate that here the segmentation is not "superficial;" while on the other hand, there is nothing in either

account that would indicate any migration toward the surface like that in Crangon. The origin of the nuclei of the "yolk cells" was not traced.

In the spiders, according to both Ludwig (**'76**) and Locy (**'86**), the process of segmentation is readily brought into accord with that in Crangon. According to the latter author, the segmentation nucleus, surrounded with a mass of protoplasm which sends off processes among the yolk granules, occupies a position in the centre of the egg; while the outside of the egg is covered with a thin layer of non-nucleated protoplasm, the blastema, the existence of which was denied by Ludwig. At the first segmentation, this nucleus divides into two and with it the protoplasm also divides, while traces of a similar segmentation can be seen in the deutoplasm. These nuclei now occupy a subcentral position in the egg. At the eight-cell stage, the nuclei are still nearer the centre than to the surface; and even when the egg has at least thirty cells, none have emerged at the surface. Later, they do appear and then the contiguous protoplasm of the blastema unites with that surrounding the nucleus, derived from that originally in the centre of the egg, and in this way the blastoderm is formed. It is to be noticed that the emergence of the internal cells takes place first at that portion of the egg known as the animal pole, and only later do they appear on the other portions. The bearings of this will appear a little farther on.

In the case of the Hexapods the great bulk of the evidence is certainly in favor of the view of segmentation which I have thus shown to be the case in spiders and decapods. Without attempting an exhaustive review, we may summarize our knowledge as follows: Although many writers (*e. g.*, Korotneff, **'85**, p. 571) confess their inability to connect the nuclei of segmentation with the

"Keimbläschen," there can be no doubt, in view of what is known of the eggs of other animals, that they are derived from it. This egg-nucleus has at first a central position, and hence in its segmentation we have a parallel to that already pointed out in spiders and decapods. Several writers (Brandt, '69; Bobretzky, '78) have failed to recognize or have denied the presence of a blastema[1] first pointed out by Weismann ('63) in the eggs of Chironomus and Musca; but this seems a point of minor morphological importance, and its existence is readily to be explained in those forms where it occurs on the ground of a precocious accumulation of protoplasm on the surface of the egg where it is soon to be utilized in the formation of a blastoderm. The amount of protoplasm thus early segregated probably differs with the species.

In some eggs the nuclei resulting from the earlier segmentations are certainly surrounded with protoplasm, thus presenting a close similarity with the egg of Crangon; and these migrate to the surface to form the blastoderm in almost exactly the same manner as in that form or as in Agelena as described by Locy and the older authors. Thus Bobretzky ('78), in the lepidopterous genus Porthesia, speaks of these nuclei and the surrounding protoplasm as true cells. Graber ('78) describes in several

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[1] The view of a blastema here adopted is that of Weismann ('63, p. 111): "eine dünn Schicht einer vollkommen homogen, stark lichtbrechenden, bläulichen Masse,"—and differs considerably from that of Patten ('84, p. 563). The blastema is composed of protoplasm and contains no nuclei; when the latter enter it, it is converted into a blastoderm, no matter whether the cell walls are developed or whether the layer has a syncytial nature. Patten says, "it is not impossible or even improbable that a 'blastema' may occur in some instances without nuclei, although at present this has not been observed to occur." Weismann in both Chironomus ('63, pl. vii, fig. 1) and Musca (pl. x, fig. 52, 52a) clearly shows that in these forms it does occur. Metschnikoff also shows it in Cæcidomyia ('66, pl. xxiv, fig. 8), Aphis (pl. xxviii, figs. 3, 4, 5) and Aspidotus (pl. xxxii, fig. 2). Witlaczil ('84, p. 567, pl. xxviii, figs. 3–7) confirms the observation on Aphis, while Locy ('86, pp. 67-70) clearly shows its nature in the spiders.

genera (Lina, Pyrrhocoris, etc.) a number of amœboid cells in the centre of the yolk which appear to be in the process of division and to be connected together by a protoplasmic network. Ayers ('84), studying Œcanthus, finds in the yolk both amœboid nuclei and amœboid cells, some of which migrate to the surface, and the cells, joining each other by a fusion of the protoplasmic filaments, form the blastoderm. Patten ('84) could not see the nuclei arise into the blastema in the living egg of Phryganids. In his earliest stages, the blastema, though not divided into distinct cells, was nucleated, while below this were numerous amœboid cells, distributed through the yolk and connected by protoplasmic filaments. In later stages these cells have almost entirely disappeared, while the blastoderm has become much thicker and the nuclei more numerous; from which the conclusion is obvious that the nuclei formerly seen in the yolk have migrated to the surface. Korotneff ('84) does not recognize a blastema in Gryllotalpa. He has the blastoderm arise by a migration of amœboid cells to the surface.

In other eggs (*e. g.*, Aphis, Metschnikoff, Witlaczil) it has not been shown that the nuclei, before leaving the centre of the egg, have each their own proper protoplasmic envelope; but in these cases there can not be the slightest doubt that the segmentation proper takes place, at first, not on the surface, but in the centre of the egg. According to Witlaczil ('84), the nuclei in Aphis do not reach the surface until sixteen of them are formed. These observations, as well as those quoted before, show that the view of Robin ('62) that the nuclei of the blastoderm arise by budding is as little justified by facts as that of Weismann ('63) that they arise spontaneously. They do, however, conclusively show that we do not have here a "superficial" segmentation, but instead one which is

readily reduced to the normal alecithal type. The protoplasm segments, the yolk in most hexapods and some crustacea, does not, but this yolk in either group is to be regarded as superficial rather than central, and the term ectolecithal, though not necessary, is far preferable to endo- or centrolecithal. The view I take of this segmentation is essentially the same as that of Bobretzky ('78) and I fail to see the force of the objections raised to it by Balfour ('80, p. 98). The nuclei, and the surrounding protoplasm, are clearly to be regarded as cells, and that they do move about with comparative freedom in the yolk is shown in almost every hexapod and many crustacean eggs. The segmentation of the yolk, like the yolk itself, is a secondary feature ; and the fact that it truly segments in Astacus, Homarus and Eupagurus while in Crangon and Peneus it does not, shows the slight importance of this point. In Eupagurus several divisions of the nuclei and the surrounding protoplasm take place before the appearance of the segmentation planes which are to divide the yolk. A still further postponement of their appearance would give us the condition occurring in Crangon or in the Hexapods. Balfour quotes his observations on the eggs of spiders in support of his position, but Locy's observations on still earlier stages of the same genus (Agelena) are readily made to support the view here adopted. The segmented hexapod egg is not a syncytium ; the cells are completely divided or nearly so and the intercellular spaces are occupied by the yolk which is here certainly to be regarded as a secondary element in the egg.

Having thus described the phenomena of segmentation in the more common type of arthropod egg we may proceed to the discussion of the gastrula, leaving until later the meroblastic and holoblastic segmentation occurring in some forms.

In Crangon, so far as I have been able to see, all the amœboid cells reach the surface and take part in the formation of the blastoderm before the process of gastrulation begins. In that form no yolk pyramids occur. In Astacus, Lereboullet ('62), Bobretzky ('73) and Reichenbach ('77 and '86) have shown that they do occur, and Reichenbach shows that they terminate in a central mass the nature of which is doubtful. In Atyephyra (Ishikawa, '85) the yolk pyramids are less evident, but in Palæmon (Bobretzky '73) they are almost as plain as in Astacus, although here the central mass is absent. In both Palæmon and Astacus, as well as in Eupagurus, all of the protoplasm (certainly the nuclei) is used in forming the blastoderm, unless the central mass have a nuclear or a protoplasmic nature. In Atyephyra, on the other hand, Ishikawa figures numerous amœboid cells remaining behind in the yolk after the blastoderm is formed and when the process of gastrulation has begun.

The process of gastrulation in the decapods is so evident that there is no difficulty in connection with it. The invaginated entoderm may either contain a lumen (archenteron) as in Astacus, or it may be solid as in Palæmon, Atyephyra, Crangon, and Eupagurus. In the former case the deutoplasm is between the entoderm and the mesoderm and ectoderm; in the latter the entoderm cells form a more or less complete wall around the yolk, so that this substance comes to occupy the potential archenteric cavity. There is but little to be said on these points beyond what has been already said by other writers and hence no further discussion is to be given here. Among the other arthropods however there are some points concerning which there is a difference in interpretation and hence these may receive some light from the conditions occurring in Crangon and its allies. The confusion which has existed is my only excuse for the following excursus.

Regarding the entoderm in the hexapods and its relation to the gastrula, various views have been held. The older authors did not trouble themselves much concerning this question, but usually regarded the germinal area as several cells in depth. Kowalevski ('71) was the first to cut sections of the hexapod embryo and to introduce the germ layer theory into the group of arthropods. In Hydrophilus, Apis, Phryganids and other forms, Kowalevski noticed the groove on the ventral surface of the embryo, and in sections saw arising from the edges of this groove another layer which in Hydrophilus (*l. c.* pl. IX, fig. 23) contained a distinct lumen. This was very naturally interpreted as an invagination for the production of the entoderm; but he also discovered that the mesodermal tissues also arose from the same layer, which led him to regard this band of tissue as different from the entoderm (Darmdrüsenblatt) of vertebrates (p. 58). A little later, Haeckel in his papers on the "Gastræa Theorie" ('75) adopted Kowalevski's view, considered this a true gastrulation, and regarded the portion thus invaginated as a true entoderm. Hatschek, studying Bombyx ('77), did not pay much attention to this layer, but (p. 117) describes it as small in amount and limited to the most anterior part of the primitive streak, in front of the segmenting embryo. Graber ('78) also regards the process described by Kowalevski in Hydrophilus as a true gastrulation and says that in Musca it is so well developed "dass man wirklich, wie bei einer typischen Gastrula, von einer Doppelphase reden kann." In Pyrrhocoris and Lina the process is different, for besides the cells arising from the primitive groove, the inner embryonal cells, which have marked amœboid characters and which are the 'Wanderzellen' of the older authors, enter into the formation of the mesenteron, which thus has a double origin.

Bobretzky ('78) thinks that, in the Lepidoptera, while some of the cells migrate to the surface to form the blas-

toderm, some remain behind in the yolk to form the centre of the yolk spheres; and though he has not carefully traced the history of these he believes they form the entoderm. The views of Tichomiroff ['**79**], though differing much from those of Bobretzky, are still capable of being reconciled with them in their broader features.

Balfour, usually so prolific in explanations, does not appear to have expressed any very definite reasons for his ideas of the morphology of gastrulation in the higher arthropods. In his studies on spiders ['**80a**] he does not consider the segmentation, but regards the yolk spheres (each of which is nucleated) which fill the egg after the formation of the blastoderm as constituting the entoderm. In his Comparative Embryology ('**80**, pp. 336, 378; '**81**, p. 278) he extends the same view to the hexapods; claims that the primitive groove is not a gastrula; regards the yolk cells as endoderm, and while stating that the mode of formation of the endoderm in the 'tracheates' reminds one of delamination, "there are strong grounds for thinking that the tracheate type of formation of the epiblast and hypoblast is a secondary modification of an invaginate type", and further, that the primitive groove may be a modified blastopore.

The Brothers Hertwig ['**81**], recognizing the difficulties which surrounded the interpretation of the gastrulation in the hexapods, studied the early development of Noctua, and for the first time gave a clear interpretation of the phenomena in accordance with the gastrula theory. According to them, the primitive groove is an actual blastopore, and it must be considered that both the nucleated yolk and the mesoderm are potentially invaginated; but that the abundance of yolk has prevented the entoderm (yolk) cells from reaching the surface and taking part in the formation of the blastoderm, and also that the same substance has

prevented any saccular invagination and the formation of an actual archenteron. This view is good as far as it goes; but, as will readily be seen, it leaves some points unexplained.

Tichomiroff's final paper on the development of the silkworm (**'82**) is unfortunately buried in the Russian language, and all ordinary students must depend upon abstracts for their knowledge of its contents, together with an inspection of the cuts in the text and the figures on the plates; there being, fortunately, no distinctively Russian method of drawing. The blastoderm is formed by a migration of cells to one pole and the neighboring sides of the egg (*vide* fig. 11, p. 28). Not all the cells thus come to the surface but some remain behind in the yolk. These are distinctively amœboid in shape and form, the "primitive entoderm." With regard to the "secondary entoderm" he agrees with Bobretzky. After the formation of the amnion and serosa and their union over the germinal area, the primitive groove appears, deeper and more symmetrical in front than behind (*vide* figs. 14 and 15, p. 33). It later closes, but not completely behind; but before its closure the mesoderm appears from both ectoderm and entoderm, and not only from the region beneath the primitive groove, but from all parts of the ectoderm. There is nothing in the sections figured to warrant the statement that the mesoderm has such a wide origin; the arguments for it in the text remain sealed.

Weismann (**'82**) describes the early stages in several species (Rhodites, Biorhiza, Chironomus, Gryllotalpa). The account, so far as statements of facts go, is most detailed with Rhodites. Here we have to do with two elements: the ordinary cells, all of which migrate to the surface to form the blastoderm; and the two "polkern," one of which is placed at either pole of the egg. From the anterior of

these "polkern" arise the inner "keimzellen." Besides this, a gastrulation is described which is peculiar in being at right angles to the longer axis of the egg and to the normal primitive streak. Its history is not traced, but one can hardly resist the impression that this structure has nothing to do with gastrulation, but is merely a folding of the ventral surface of the egg. Certainly the figures will support such a conclusion.

Dr. Ayers ('84) describes the early history of Œcanthus and differs from all other authors as to his interpretation of the primitive layers. According to him the blastoderm is to be regarded as largely entodermic, the ectoderm at first forming but "a small area on the dorsal side in the region of the gastrula mouth," which gradually "encloses the yolk and endoderm by a genuine epibole." As I understand his description, he regards the germinal area and the amnion as the ectoderm, while the serosa is entoderm, the yolk being "an inert mass of food substance between the particles of which numerous *indifferent cells* are found." Hence the line between the amnion and serosa is to be regarded as the boundary between ecto- and entoderm. These membranes now fuse so as to form the well-known double envelope about the germinal area and then the second fusion takes place followed by the rupture in the place of fusion, and eversion of the embryo. The serosa now contracts and pulls the amnion from the dorsal surface, while its cells gather together and form a yolk sac which at last comes to lie within the body, being last seen at the back of the head. The amnion is distinctly stated to form the dorsal wall of the insect, while "the serosa functions as a yolk sac" and the "so-called dorsal organ is but the remnant of the yolk sac" (p. 261). In various places the serosa is spoken of as an "endodermic sac," while, in figures 36 and 37 on p. 260, the serosa is

labelled "*en*" (endoderm), and the dorsal organ "*gast. mo.*" (gastrula mouth). It would seem as if the only interpretation to be placed on these facts is that the serosa is regarded as the endoderm and the dorsal organ as the gastrula mouth. In a note on p. 261, Dr. Ayers modifies some of these statements in the light of Balfour's researches on the embryology of Peripatus. He now regards the primitive groove as produced by an elongation of the blastopore and says that in some insects this groove, with the mesoderm arising from it, is to be regarded as the only indication of the previous existence of a gastrula mouth. This of course modifies many of the other conclusions summarized above, but to what extent does not readily appear from the text.

Patten says ('84) that in the Phryganids all the nuclei of segmentation migrate to the surface and take part in the formation of the blastoderm, leaving the yolk entirely free. Then (p. 573) "the endoderm arises from any point in the blastoderm by delamination, and the process may continue even after the blastoderm has been converted into the ventral plate." In support of this view he figures (pl. XXXVI B, fig. 5) a section of an egg with the ventral plate well-differentiated, in which cells which he regards as yolk cells or endoderm, are budding from the dorsal portion of the blastoderm (serosa). In another place (p. 572) he says that the cells arising from the primitive groove ("gastrula") are to be regarded as both mesoderm and endoderm, and farther on he describes and figures amœboid cells, like those mentioned above, budding from the mesoderm and extending into the yolk. What the fate of these latter is he is not prepared to say, but he is not ready to affirm that the result of this is to increase the number of yolk cells. We may note in passing, that Doctor Patten mentions the fact that no

karyokinetic figures were visible in the young stages, even where cell division was actively going on.

Witlaczil, in his masterly paper on the development of the Aphides (**'84**), agrees with the others that the nucleated yolk spheres represent the endoderm and that they later give rise to the "Wanderzellen," of whose wandering, however, he has doubts. These yolk spheres he regards as products of segmentation, but he makes no comments upon their relations to the blastopore or to any invagination.

Korotneff (**'85**), studying Gryllotalpa, arrives at conclusions much like those of Patten. The yolk cells all migrate to the surface and there take part in the formation of the smooth blastoderm. Here some of the blastodermic cells (usually in the neighborhood of the scarcely apparent primitive streak) become larger than their fellows and send protoplasmic prolongations down into the yolk, and then sink themselves into that substance. This takes place by scattered cells here and there and forms what this author terms "diffuse gastrulation." He makes no mention of mesodermal cells sinking into the yolk, but derives his entoderm solely from these amœboid cells arising from the blastoderm. This constitutes one of the differences between him and Patten; another consists in the fact that Patten has the yolk cells budded from those of the blastoderm, while Korotneff has the blastodermic cells themselves sink into the yolk.

Bruce has a different view. In Thyridopteryx (**'85**) the germinal area becomes two cells deep, apparently by a delamination which takes place beneath and at the sides of the primitive groove. The inner layer then separates from the other and, splitting into two bands, grows laterally and dorsally, and portions of it then extend around and enclose the yolk. These are said to "form the epithelium

of the mid-gut and consequently are to be regarded as endoderm cells." The large yolk cells are not regarded as taking any part in the formation of the endoderm, but nothing is said of their fate. Apparently (if we may judge from the two figures given) the process in Thyridopteryx is much like that in Noctua, as described by the Hertwigs, and the layer which Bruce describes as endoderm is regarded as mesoderm by them. In Bruce's fig. 2, this layer bends around almost exactly as it does in Noctua to form the splanchnopleure. Bruce's "clear migratory cells" are not represented in Noctua. Bruce says nothing of their fate nor does he indicate how the mesoderm arises. While he quotes Balfour, Kowalevsky, Tichomiroff and Dohrn, he fails to refer to the Hertwigs in connection with the origin of the endoderm.

In the bee, according to Grassi ('85) the blastoderm is formed by a migration of the amœboid cells to the surface where, at one end of the egg, they at first form a layer of cells which gradually increases until the whole is covered, just as was described by Kowalevsky. Numerous nuclei are left in the yolk. In the median ventral line the formation of the mesoderm takes place, a broad plate of the blastoderm sinking and being overgrown by the remainder of the blastoderm. At first this mesoderm is a single cell in thickness, but it soon becomes two or more cells deep. This closing in takes place first in the anterior third of the embryo and is concluded at the posterior end of the germ. After this mesodermic plate is formed and enclosed by the ectoderm it grows forwards and backwards beyond the limits of its origin, curving at either end to surround the yolk. It is these terminations that Grassi regards as forming the endoderm. In other words he derives the endoderm from the anterior and posterior ends of the mesodermal plate. He refers to numerous sections

figured to support this view but they are to me far from conclusive. Indeed they do not in the least appear to support him; but on the other hand seem to be in full accord with the explanation advocated below. In a second portion of his paper (Ital. edit., pp. 191–194; French edit., 267–268) he says that this mode of origin is in full accord with the theory of the gastrula, that the line of invagination is to be regarded as an elongate blastopore, the invaginated tissue is to be regarded as a meso-entodermal layer and that gastrulation is here rudimentary rather than falsified, the nutrition rendering a perfect gastrula unnecessary. Concerning the yolk cells, which are clearly like those of other arthropods, our author says that he has never seen them take any part in the formation of the endoderm. The lack of method in the arrangement of his figures renders it a difficult task to follow the sequence of his sections; but a study of figs. 3, 13, 14, 29 on pl. VII, figs. 6, 7 on pl. VIII, as well as many others, would seem to show beyond a doubt that the endoderm in the bee was formed by a migration of the amœboid yolk cells to the surface of the yolk and their arrangement there into an epithelial layer inside the mesoderm and resting directly upon the yolk. The appeal to figures like pl. VII, fig. 4, to prove that the yolk cells take no part in the formation of the endoderm is far from conclusive. Further studies on the development of the bee will be necessary before this question can be regarded as settled. Grassi thinks that the results of the Hertwigs and Tichomiroff ('82) can be explained to agree with his views, but this does not readily appear.

From this review (which is not exhaustive) we see that there have been almost as many theories as writers concerning the origin of the endoderm in the hexapods and its relation to the gastrula. It has not been our purpose

to trace their results beyond the point of the recognition of the three layers and hence we have omitted those portions which treat of the modification of the primitive endoderm into the epithelium of the mesenteron. Since Haeckel, most authors have realized that the primitive groove is in some way connected with gastrulation and many are of the idea that the yolk cells and the "Wanderzellen" have a part to play in the formation of the endoderm. Not so Dohrn. He says ('76) that they have no connection with the primitive groove though they may come to lie beneath it. The "Wanderzellen" occur in the adult as well as in the embryo. They form the fat bodies and the blood and they pass out through the dorsal organ into the space between the embryonic envelopes. He also mentions that the neurilemma is derived from similar appearing cells. It is highly probable that Dohrn has taken similar appearance for actual identity and has confused amœboid mesoderm cells with similar cells derived from yolk cells which are really endodermal.

Of the early stages of the myriapods we know comparatively little. Stecker ('77) describes a regular gastrulation in four genera of Diplopods (Iulus, Craspedosoma, Polydesmus and Strongylosoma) but a glance at his plates convinces one that his statements deserve the criticism to which Balfour subjects them. More recently, Heathcote has investigated the development of Iulus and his account, ('86) while confirming that of Metschnikoff, adds other details. The nuclei of segmentation, each surrounded with protoplasm, migrate to the surface to form the blastoderm, the later nuclei uniting with others derived from the blastoderm to form a keel like that described by Balfour in Agelena. This keel furnishes the mesoderm, and Heathcote regards it as homologous with the primitive streak of other arthropods. Other nuclei remain in the yolk and

these eventually become partly mesodermal and partly endodermal. Metschnikoff's slight account of the early stages of Geophilus would indicate that the Chilopods are much like the Diplopods. Sograf ('83) has a Russian paper on Geophilus from which it would appear that there is a similar migration of some cells to form the blastoderm while others remain behind in the yolk.[1] The mesoderm arises in much the same way, but some of the later sections would tend to show that not all the nuclei remaining behind in the yolk were utilized in forming the endodermic epithelium but that they were utilized as food like the yolk. One figure would seem to indicate that the endoderm may bud off cells to take a place among the mesoderm.

This confusion regarding the origin of the endoderm in the hexapods, arachnids and myriapods, and the belief that the facts shown by the decapods aid in an interpretation of the various phenomena are my excuse for thus taking up more space than, perhaps, the subject demands. The existence of a gastrula stage in all Metazoa, whether of the type of "archigastrula" or of some of the numerous modifications recognized by Haeckel, is admitted by all; but, so far as I am aware, no one has as yet brought the hexapods in full accordance with that theory. My present attempt may not be deemed more satisfactory than the twenty or more that have preceded it; it has, however, the merit of reconciling more facts than any other.

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[1] In the abstract quoted from (see bibliography) it is stated that the eggs of myriapods are very peculiar in that they have the protoplasm at first at the centre, the cells migrating to the surface, and it is suggested that this probably distinguishes them from the Arthropoda "since in no other arthropodous form does the vitellus so constantly occupy a superficial position and so completely invest the first segmentation cells, which are then aggregated in a cluster at the centre of the egg"! It is one endeavor of the present paper to show that just this condition is characteristic of the Arthropoda as a whole; and (Tetranychus and the meroblastic forms excepted), so far as the writer is aware, there is not a single arthropod in which there is an abundance of food yolk but what has just this type of egg, here regarded as decidedly myriapodous.

From our historical review it will be seen that the great majority of the evidence is in favor of the following points:—(1) The segmentation begins at the centre of the egg. (2) The blastoderm is formed by the migration of the cells produced by segmentation to the surface. (3) The endoderm, in many types of hexapods is formed by cells which remain behind in the yolk. (The exceptions to this will be considered later.) To these a fourth is to be added, which is so generally recognized as to need but little argument:—The primitive groove of hexapods is the homologue of the blastopore. This is shown by its relations to the origin of the mesoderm and, later, of the nervous system, which are almost exactly like those of vertebrates,[1] where the same homology is recognized. Except in a few cases in the hexapods (Korotneff, Patten, Bruce, etc.), it is not claimed that the primitive groove is in any way connected with the actual production of the endoderm or that there is any passage of cells from the blastoderm to the interior of the egg. How then has this state of affairs arisen? and how is it to be explained?

In all these there is a migration to the surface closely like that of Crangon. Now, in this genus (and the same is apparently true of other forms, *e. g.*, Atyephyra) the majority of these migrating cells go to form the germinal area, more going to that region than to any other, and, as fig. 9 shows, the later migration is all toward that point. Here it is that the gastrula is formed, and as a necessary result some of these very cells are returned by that operation into the yolk from which they have just emerged. Should some of these migrant cells be still farther delayed, it is a plausible supposition that they might be-

[1] As will be shown later, the supra-œsophageal commissure, which completes the œsophageal ring and thus makes the invertebrate nervous system so different from that of the vertebrate, is developed after the rest of the system is outlined.

come entangled among the invaginating cells and thus be carried back into the yolk where they would form a part of the endoderm without ever having taken part in the formation of the blastoderm. Such an effect might result from an increase of deutoplasm in proportion to the protoplasm. Still further increase it and more cells would be delayed and finally enough would remain in the yolk to form the whole of the endoderm. Such a process is in perfect harmony with the theory of acceleration and retardation of Professors Cope and Hyatt; and it would be accompanied by a considerable saving of vital force to the egg.

The endoderm cells in eggs with a large yolk need to take a position in close connection with the deutoplasm, for from the moment of their formation they are actively engaged in assimilating it (*cf.* Reichenbach, '86, pp. 101–102, pl. VIII, fig. 67); hence any process which leaves them scattered through the yolk is an evident advantage to the embryo. The mesoderm, on the other hand, is first needed in the neighborhood of the developing appendages where muscles, etc., will be earliest required, and hence it is no economy to the individual to change the mode of its formation. From this reason, as well as from heredity, the egg would retain the appearance and go through the motions of gastrulation, even though it formed no endoderm by the operation, and the result would be such as has been described by the majority of observers.

The conflicting accounts of recent date are those of Bruce, Patten and Korotneff. In the case of Bruce ('85) I think a reconciliation is to be effected on the supposition that he has misinterpreted his observations. A comparison of his account with that of the Hertwigs seems conclusively to show that the yolk cells are to be regarded as

endoderm, while his endoderm is clearly the splanchnopleure of the authors of the "Cœlomtheorie." The observations of Korotneff ('85) and Patten ('84) are less easily explained, for both state that cells arise from all parts of the blastoderm and pass into the yolk to form the endoderm, and that before this "diffuse gastrulation" more are left in the yolk. Were it not for this, the statements and figures of Patten (p. 572, pl. XXXVII B, fig. 12) that the primitive streak "gives rise to a part of the endoderm and all of the mesoderm," might be readily understood as the last stage in a process of gastrulation previous to the condition of affairs which we have supposed above. Korotneff's recognition of two mesodermal elements — myoblasts and mesenchyma—and his description of their mode and places of origin still further complicate the matter and make a reëxamination of his results desirable.

While upon this subject of arthropod segmentation and gastrulation it may be well to refer to another point which seems to have caused considerable trouble, and for which an explanation is apparently more easy than in the cases already discussed. In a few arthropods — Scorpio (Metschnikoff, '71), Nebalia (Metschnikoff, '68), Mysis (Van Beneden, '69[b]), Oniscus (Bobretzky, '74), and Cymothoa (Bullar, '78), the segmentation is of a meroblastic character, recalling quite strongly that of the meroblastic vertebrates or even of the teleosts. While we greatly need new observations upon these forms I think the facts in our possession fully warrant us in regarding them as not greatly different from the more normal types.

In all arthropod eggs there is a certain amount of polarity and in some it becomes quite marked, the cells appearing at one point more abundantly and earlier than at others. This was noticed by Locy in Agelena, but is more apparent in the cases of Aphis, Gryllotalpa, and, it

would seem, in Neophalax.[1] In the mite, Tetranychus (Claparède, '68) the process has gone a step farther, for here the segmentation nucleus reaches the surface before it divides. In this case the segmentation is necessarily superficial, but it takes but a very short time to have the whole surface of the egg covered with nuclei, a process which is apparently completed before the appearance of anything like a germinal groove. In this connection, Claparède's pl. XL, figs. 1, 2 and 3, are instructive, for they clearly show us that a *superficial* segmentation in the Arthrópoda is necessarily meroblastic, though here this condition lasts but a short time. A superficial segmentation demands that both nucleus and protoplasm be placed practically at the surface of the yolk; in other words, an egg which cannot be distinguished from one of the regular meroblastic type. When segmentation commences, it must necessarily begin at the pole occupied by the nucleus; and, for at least the first few divisions, proceed most rapidly in that region, the result being a meroblastic segmentation, which cannot be defined as distinct from that occurring in Cephalopods, Elasmobranchs, Sauropsida, etc. It is certainly superficial, but superficial exactly in the same way as in those forms mentioned which have never been classed in the category of "centrolecithal eggs."

From the condition which occurs in Tetranychus, it is but a step to that occurring in Oniscus, Scorpio, etc. In these the segmentation nucleus reaches the surface before or soon after segmentation begins, but the resulting blastoderm spreads more slowly over the yolk than in the mite just mentioned, differentiation of the germ layers taking place before the blastoderm covers half the yolk. Gradually, however, the blastoderm completely covers the yolk.

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[1] "Ten or twelve hours after oviposition . . . a clear space makes its appearance at the surface of the egg and gradually increases until it has attained the breadth of the future blastoderm" — Patten ('84, p. 563).

Balfour apparently confounded this with an epibolic gastrulation, for (**'80**, p. 99) he seems to think that the closure of the blastoderm is synonymous with the closing of the blastopore, hence in these cases the blastopore would be situated on the dorsal and not on the ventral side of the ovum. Again (p. 378), he says "The growth of the blastoderm over the yolk in scorpions admits no doubt of being regarded as an epibolic gastrula. The blastopore would, however, be situated dorsally, a position it does not occupy in any gastrula type so far dealt with. This fact, coupled with the consideration that the partial segmentation of Scorpio can be derived without difficulty from the ordinary Arachnidan type, seems to show that there is no true epibolic invagination in the development of Scorpio." That he nevertheless adhered to the first of these rather conflicting ideas is seen from his statement a year later (**'81**, p. 282) that "the epibolic gastrula of the scorpion, of Isopods and of other Arthropods, seems also to be a derived gastrula." Ayers holds a similar view for he says (**'84**, p. 261) :—In Scorpio, Mysis and Oniscus, the blastopore is dorsal in position."

This view seems to me totally erroneous. If true, it introduces some wonderful differences into the arthropods and makes it impossible to trace close homologies between forms as closely related as Mysis and Peneus; for in the latter case the blastopore is certainly ventral in position, if we can trust Haeckel's figures. Unfortunately, we know almost nothing about the inner germ layers of Scorpio, but the little that Metschnikoff tells us (**'71**) is apparently in accord with Bobretzky's account of Oniscus (**'74**) and since the latter is much more fully described and moreover was studied by sections, it may be taken to represent these meroblastic crustacean ova.

When the blastoderm of Oniscus covers about a third of the egg, lower layer cells appear between it and the yolk

and, rapidly increasing in numbers, split into two layers, thus becoming differentiated into meso- and endoderm. The cells of the latter layer sink into the yolk, "den ganzen Nahrungsdotter in sich einsaugen," and thus convert the interior of the egg into a mass of yolk spheres which Bobretzky says form the endoderm. In Scorpio, Metschnikoff's plates certainly leave much to be desired; but his figures 7 and 9 on plate XIV can be reconciled with the condition occurring in Oniscus, if we interpret the layer cells of fig. 7 and the "zweites Blatt" of fig. 9 as mesoderm. Haeckel's interpretation is apparently wrong. In Cymothoa the conditions are apparently the same as in Oniscus. Van Beneden tells us nothing of the formation of either mesoderm or endoderm in Mysis, but the subsequent development would indicate a similarity to Oniscus. The same remarks would apply to Nebalia.

In Oniscus, Bobretzky says there is no invagination, but he says that here the lower layer cells arise from the blastoderm. Delamination here is of a different nature from that in the Cœlenterates and is easily seen to be but a slight modification of gastrulation. This gastrulation takes place at or near the middle of the germinal area, and there is to be sought the blastopore. We know nothing about the presence or absence of a primitive groove in any of these forms. Such being the case, the gastrulation of these genera is of a very different character from that of the teleosts and some other vertebrates where the rim of the blastoderm is clearly the blastopore. In these arthropods there is merely an acceleration of development, whereby the gastrula is formed before the blastoderm has had time to spread over the very large yolk. The case offers a close parallel to that of the chick. The edge of the blastoderm has nothing to do with the formation of either mesoderm or endoderm, and, hence,

except in its closing, it has nothing in common with a blastopore.

Nusbaum ('86) failed to see the first stages in Oniscus but that he takes essentially the same view of the blastopore as that here advocated is readily seen. "Au milieu du disque de segmentation (blastopore) formé par une seule couche de cellules, apparaît une accumulation des cellules (gastrulation), dont une partie, comme Bobretzki l'a bien remarqué s'enfonce dans le vitellus, pour l'absorber et pour former des cellules vitellines (Dotterzellen) une autre partie reste diffuse au dessous de l'ectoblaste et donne naissance, d'après l'auteur cité, aux éléments du mésoblaste ; selon mes recherches cette seconde partie donne non seulement le mésoblaste, mais encore l'entoblaste." Nusbaum does not regard the "Dotterzellen" as true endoderm but thinks that they play a part in the softening of the yolk. His endoderm is derived from two lateral masses at the anterior end of the meso-endodermal thickening and these give rise to the endoderm of the hepatic cœca which Bobretzky thought arose from the yolk cells. He refers to a recent Russian paper by Kowalevsky on the development of the scorpion as agreeing with his results. This I have not seen. Kowalevsky and Schulgin have a short paper on the embryology of this form ('86) which came to hand after the present paper was in the hands of the printer, and which doubtless contains the same facts as that referred to by Nusbaum. Their youngest eggs had the blastoderm complete and occupying one pole of the egg, while neither nuclei nor cells were to be seen in the yolk. The rudiments of the middle and inner germ layers first appeared as a thickening in the middle of the under surface of the blastoderm ; and "nicht selten kann man konstatieren, dass mehrere Zellen von den obern Schicht nach innen getreten sind," certainly indicating a

solid invagination. The authors at first regard these invaginated cells as entoderm but later as ento-mesoderm. From the lower surface of this layer many cells bud off and sink into the yolk to form yolk cells, which, the authors say, play no part in the development of the tissues, but act as solvents of the yolk. Later, the true entoderm is formed by the separation of a layer of cells from the ento-mesodermal layer, which come to lie close upon the yolk. Nothing is said of the portion of the invaginated cells from which these entoderm cells arise. The mesoderm is later in becoming differentiated.

Nusbaum's observations as to the place of origin of the entoderm seem to afford a partial support to those of Grassi on the bee noted above; but without illustrations it is not easy to see how far this is really the case. Kowalevsky and Schulgin do not say whether the entoderm arises from the whole lower surface of the invaginated cells or from their anterior region. All three agree, however, in saying that the yolk cells play no part in the formation of the epithelium of the mesenteron. In this connection my own observations ('85) on the development of Limulus are of interest. Nothing is known of how the yolk cells arise in that form, my few observations only lending probability to the view that they are derivatives of the early segmentation which do not migrate to the surface. My sections, however, seem capable of but one interpretation—that the peripheral yolk cells eventually form the epithelial lining of the liver and the intestine and that they gradually devour those lying inside them, thus producing the lumen of this portion of the alimentary tract. To a certain extent these observations are reconcilable with those just noted; for, in Limulus, the yolk cells break up and digest the yolk, but some of them beside seem to be true entoderm for they form a true entodermal tissue.

A reconciliation of the differences will only be possible upon the publication of figures and a detailed account of the processes in Oniscus and Androctonus.

The observations on the relations of the mouth and anus to the blastopore in the Crustacea are extremely few. Reichenbach's account of Astacus ('86) is by far the most complete and conclusive, and there the anus is clearly in front of the position of the blastopore. Ishikawa ('85) has the same result in Atyephyra; and in Crangon, though not certain, I still think that the anus occupies a similar position with reference to the blastopore. In none of the Crustacea do we find that elongate blastopore (primitive groove) which is so characteristic of the tracheate arthropods and the fact that the blastopore entirely disappears before the appearance of either permanent opening of the digestive tract renders it rather difficult to trace their general relationships. Reichenbach's studies and his figures ('86, pls. II and III) seem to be conclusive upon the point that there is no proliferation which would extend the limits of the circumblastoporal cells as far forward as the point where the mouth is formed or even far enough to include the anus.

In Crangon I have been unable to recognize but one kind of mesoderm and that is not differentiated until gastrulation. It arises, as numerous sections show, from the edge of the blastopore and from nowhere else. Bobretzky recognized but one kind of mesoderm in Palæmon, but this arose from cells clearly endodermal. Reichenbach ('77 and '86) has a secondary mesoderm which is budded from the true endodermal cells after the process of gastrulation is completed. Ishikawa, in Atyephyra, also has two kinds of mesoderm, one arising from the edge of the blastopore; while the other arises from the

endoderm, all of the endodermal cells elongating and budding off cells which go to make up the third germinal layer. The earlier of these mesodermal cells of endodermal originally closely resemble their fellows, but later they are much smaller and stain more deeply. These latter are regarded as comparable with the secondary mesoderm of Reichenbach. It does not appear that either of these two groups of mesoderm fall under the head of the mesenchyme of the Hertwigs.

Reichenbach claims that in Astacus the mesoderm is differentiated before the actual gastrulation, and he figures mesodermal cells in advance of the blastopore. This reminds one of Grobben's studies on the Entomostraca. In Cetochilus at the thirty-two cell stage there are already differentiated one mesoderm and two endoderm cells, besides two more which are partly mesodermic and partly endodermic, but it is to be noticed that, according to Grobben's interpretations, the mesodermic cell is *behind* the endodermic ones. In Moina the same differentiation of mesoderm before invagination is noticed, and the mesoderm occupies the same position with relation to the endoderm. Here, however, the genital cells are differentiated from the other mesodermal ones before either are invaginated, exhibiting an instance of precocity only paralleled in some Hexapods (*vide* Witlaczil (**'84**, pp. 571 and 671–677).

Concerning Lucifer there is some question. According to Brooks (**'82**) the egg has a regular and total segmentation followed by a blastopore stage. At the close of segmentation one of the cells is differentiated from the rest by containing a large amount of food yolk. In invagination this cell becomes divided, and the two resulting cells do not take a part in forming the endoderm, but are pushed into the segmentation cavity. Brooks is uncertain

whether the whole of the primitive yolk-bearing cell becomes thus pushed in or whether only its deeper end is segmented off and placed into the blastocœle. The further history of these cells was not traced. It would seem probable that they go to form the mesoderm, and, if so, they would afford another instance of early differentiation of that layer. Brooks, however, is inclined to the belief that they go to form a food-yolk like that of other decapods. His reasons, however, are far from apparent.

In the other groups of Crustacea the information as to the origin of the mesoderm is extremely scanty. In Oniscus (Bobretzky, '74), it would appear that both mesoderm and endoderm are formed at the same time and are differentiated by a delamination at a later date. Bullar's results in Cymothoa do not differ greatly from this. Nusbaum's account of the process in Oniscus is summarized above. New observations are, however, greatly needed, for these accounts lack greatly in desirable details, and it will possibly prove that the origin of the mesoderm in all these meroblastic types does not differ greatly from that of the more common uninvaginate forms.

EXTERNAL DEVELOPMENT.

From this point where the three germ layers are developed, it is necessary to follow out the different organs separately, since the whole cannot be described at once. In order to have a means of correlating the stages of growth of the different systems, I give first an outline of the external features up to the time of hatching, leaving the internal organs until a later time. I may say at the outset that I do not attempt to trace the various modifications of the appendages in detail, but merely to figure and describe the general external appearance, so that the

reader may have landmarks to guide him in the discussion of the internal development.

Immediately after the gastrulation, the embryo begins to be outlined. As will be seen by fig. 8, the germinal area is mostly in front of the blastopore and is characterized by smaller and more closely placed cells. It is here that the most marked changes first take place. The next stage is represented in fig. 10; a larger and more detailed representation of this stage is shown in fig. 1 of my other paper ('87). At the posterior end of the egg is shown a broad, somewhat kidney-shaped disc, *ta*, the representative of the germinal area in fig. 8, and which, following Reichenbach, I call the thoracico-abdominal area. The blastopore closed in the median line of the posterior portion of this disc. From the two anterior angles of this disc, two cords of smaller cells extend outwards and forwards, each terminating in an oval disc or plate of still smaller cells (*ol*), the rudiments of the optic lobes for whose subsequent history the reader is referred to the paper just quoted. In the fresh egg treated with dilute alcohol, this somewhat U-shaped germ is brought into strong relief, while staining shows that it is differentiated from the rest of the blastoderm by the smaller size of the cells and the consequently closer position of the nuclei. The cells are smaller in the optic lobes and in the thoracico-abdominal area than in the cords connecting them. In section these cells are all more columnar than those of the undifferentiated blastoderm, which are very flat and much as in the earlier stages.

This stage of the egg, which I may call *A*, corresponds rather closely with Reichenbach's ('86) stages *A*—*D*, with the following exceptions: Most noticeable is the fact that I have not seen the optic lobes in Crangon before the closure of the blastopore, while Reichenbach (*l.c.*,

pls. I and II) has them well differentiated in Astacus even before invagination begins. Again, Reichenbach has the nuclei of the optic lobes and the two halves of the thoracico-abdominal region exhibiting a marked concentric arrangement. This I have not seen in Crangon. Besides these points and the relatively greater distance in Crangon between the optic and thoracico-abdominal lobes, and the smaller number of cells (a necessity from the much smaller size of the egg) our results compare favorably.

Mayer, in his studies of Eupagurus (**'77**) did not go into such detail as Reichenbach, as he did not trace the cells in his earlier stages. His figures 14 and 15 compare well with that of Crangon now under discussion, except he does not figure the cords connecting the optic lobes (Kopfanlage) with the thoracico-abdominal area. In Crangon, these cords are fainter than the rest of the germ, and hence they may have existed in Eupagurus but have escaped observation. In other respects — the shape of the thoracico-abdominal region and the distance between this and the optic lobes — there is a close resemblance between these two forms.

Accepting the terminology which Ishikawa applies to his figures of the early embryos of Atyephyra (**'85**, pl. XXVI, figs. 55 to 59) it is not easy to reconcile his results with mine. It would seem, however, that his mandibles and abdomen are not in reality such but that together they form the thoracico-abdominal region. There is, however, not sufficient evidence to decide this point as the stages between these figures and his figure 60 are lacking. If this view be the true one (his mandibles being but the lateral expansions of the thoracico-abdominal region) his results will compare well with those of Reichenbach and Mayer as well as with my own and we shall be relieved of the difficulties surrounding the appearance of the mandibles

before any other appendages are outlined. Connected with this area by a slender peduncle is a circular area interpreted as the "carapace." Unless this be what I have termed the dorsal organ which will be described later, I have seen nothing to compare with it in Crangon. The optic lobes in Atyephyra are at about the same distance from the thoracico-abdominal area as in Crangon, but Ishikawa does not represent the cords of small cells connecting them.

Between the stage just described and the next, which I designate as *B* (fig. 11) there occurs a gap in my material but the changes which have occurred in the interval can easily be understood. The embryonic area is now considerably *smaller* than before (a subject to be mentioned later), while its form has undergone considerable alteration. The optic lobes are now larger than before and more closely approximate, the broad area of undifferentiated blastoderm which formerly existed between them, (reaching back to the thoracico-abdominal area) having disappeared except for a V-shaped prolongation which extends between the optic lobes. These lobes are also much nearer the rest of the embryo ; and the thoracico-abdominal area shows the beginning of the differentiation which justifies the name applied to it. The cords of cells uniting the optic lobe with the rest of the embryo in fig. 10 have now united in the median line to form part of the ventral surface of the shrimp. The optic lobes at this stage are elsewhere described, but the rest of the embryo needs further mention.

From the lateral cords a broad plate formed by their union has developed, with the mouth, a shallow pit (*mo*) near its anterior margin, while on either side is seen the first rudiment of an appendage (*I*) which the subsequent history shows to be the first antenna or antennula. It is to be noticed that this appendage at this time is distinctly

postoral in its position. Behind this appendage this region becomes confluent with the undifferentiated portion of the thoracico-abdominal area. At the outer portion of this region the nuclei are more closely placed than in the centre, and sections show that in the former portions the cells are more columnar, while in the median line they are more nearly pavement like. The line of demarcation between the two kinds of cells is rather abrupt and indicates the division between the ectoderm of the median line and that which is to give rise to the ventral nervous cord. In the thoracico-abdominal area a differentiation is also taking place, as the abdomen is budding out. This is accomplished by an infolding near the anterior margin of the area (*af*) by which the abdomen is separated from the rest of the area, while the ectoderm, thus inpushed, forms the ventral surface of both thorax and abdomen. This inpushing does not at first take place clear across the thoracico-abdominal area, but begins near the median line and proceeds there more rapidly than at the sides, the result being to form a pouch projecting some little distance into the egg, the walls of which are formed by the ectoderm of the ventral surface. I think that Ishikawa has been misled by this development of the abdomen and has interpreted the pouch thus formed as the proctodæum. Certainly his "*pd*" in fig. 62 (**'85**, pl. XXVII) is not the hind gut, but is the beginning of the abdominal fold. In Crangon, as we shall see later, the proctodæum does not appear until some little time has elapsed. In this formation of the abdomen, Crangon agrees closely with Eupagurus. Mayer's fig. 28 (**'77**, pl. XIV) represents a condition which is frequently seen in cutting sections of the earlier stages of Crangon parallel with the general ventral surface, so far as the thorax and abdomen are concerned; the amœboid cells there figured I have not seen. The scattered

mesoderm and endoderm cells have no such appearance in Crangon.

It is at this stage that I have first distinctly seen the first embryonic cuticle, though I have seen traces of it in the stage A. It is a delicate, cuticular pellicle, secreted by all the cells of the blastoderm and forms a second envelope inside the chorion. Its fate I have not traced. What these blastodermic cuticula mean from a phylogenetic standpoint I am not ready to say. They occur in various arthropods, having been described in many Crustacea and some Arachnids as well as in Limulus (Kingsley, '85). In Atax, Limulus and Apus they form a protective envelope for the embryo after the splitting of the chorion, and in such cases Claparède's term deutova may be applied to them. In other cases they seem to play no part in the subsequent history of the animal. They clearly have no connection with the protective envelopes (amnion and serosa) of hexapods, nor have they any connection with the dorsal organ (micropylar apparatus) of the Edriophthalma. Kennel ('84) sees in them a remnant of the trochosphere of the annelid ancestor of the arthropods, a view which seems to have but little to support it.

In stage *C* (figs. 12 and 13) the optic lobes are more elongate, the upper lip (*l*) has developed, covering the mouth, while a second pair of appendages (*II*), the antennæ, have been formed between the antennulæ and the thoracico-abdominal area. The antennulæ and the mouth begin to show a change in their relative positions, for while in the last figure the base of this appendage was distinctly postoral, it has now moved forward so that the mouth is opposite the middle of the base. The abdomen is also farther developed by the inpushing of the pouch already described, the extent of which is best shown by the side view, fig. 12, *af*.

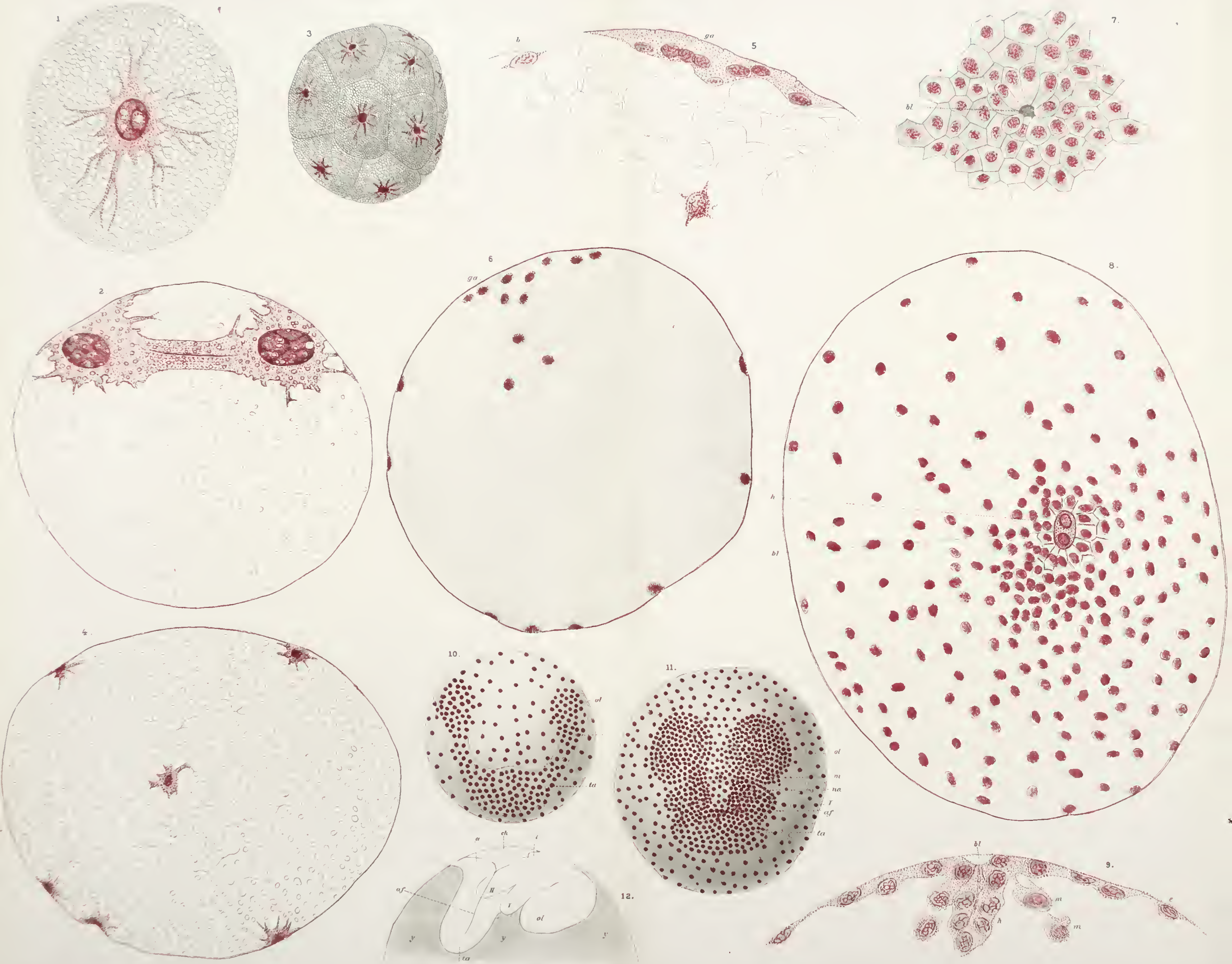
Stage *D* (fig. 14) is characterized by the appearance of the mandibles (*III*), the increase in size of antennulæ and antennæ (*II*), the indications of the supraœsophageal and optic ganglia, the larger size of the abdomen and the appearance of the rudiments of the heart and dorsal vessel, *d*. There is no longer a large space between the labrum and the tip of the abdomen, and the latter exhibits traces of segmentation. Both pairs of antennæ are in front of the mouth.

Stage *E* is another step in advance (figs. 15 and 16) in which the most marked features are the development of four pairs of appendages behind the mandibles, making seven in all (a number which persists for some time) and the biramose condition of the second antennæ (*II*). The proctodæum is also visible, although it was formed in the preceding stage.

This account varies considerably from that of other observers on the early stages of decapods. For instance, Reichenbach ('86) describes the mandibles as the first appendages to appear and then the antennulæ and lastly the antennæ,[1] thus arriving at the so-called nauplius stage. Like myself (*cf*, '86, pl. 11*a*, fig. 7*a*, "*lb*" *et* "*EII*") he has all the appendages at first distinctly postoral, while he does not find that the mouth is distinctly behind the antennæ until a stage (his "*G*") comparable to my stage *E*. This primitively postoral position of all the crustacean appendages has now been too firmly settled to admit of dispute. Ishikawa has the mandibles appear first in Atyephyra, but this, as explained above is, I think, a mistake.

There is one feature in the history which has already been detailed to which attention should be called. A com-

[1] Reichenbach regards the ophthalmic stalk as an appendage homonomous with the rest, hence there is a discrepancy of one in the nomenclature of our plates.



B. Meisel lith.

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parison of figs. 10 and 11 shows, as was mentioned above, a considerable difference in the size of the embryo, the older being considerably the *smaller* of the two, the original dimensions not being regained until the stage just past. Mayer ('77), calls attention to a similar state of affairs in Eupagurus, while Ishikawa's figures show that the same occurs in Atyephyra. In Astacus, according to measurements of Reichenbach's plates, there is a similar contraction of the germinal area, though not to so great an extent as in the other forms mentioned. So far as I now recall, this circumstance is not readily paralleled in the animal kingdom, nor is it easy to explain. Indeed, I can think of but one interpretation to be placed upon it and that is not over satisfactory. It is as follows: almost all decapods now leave the egg and begin a free life in a comparatively advanced condition, but the evidence presented by Lucifer, Penæus, etc., shows that their ancestors began their free life when much more immature[1], or at least when in a condition far less like that of existing adults than is the newly hatched embryo of to-day. There is evidence that this early crustacean had an egg with comparatively little food yolk; indeed, this element seems to have been introduced at a comparatively recent date. For such an embryo it would be a great advantage to begin its free life with only those organs necessary to its existence and hence the more rapidly the whole egg was converted into the germ the better for the individual and hence for the race. The more direct the development within the

[1] As will appear in the sequel, I do not give the nauplius that extreme phylogenetic importance which many do. I regard it as an introduced, adaptive, larval condition which, of course, has become hereditary, and marks a connection between all Crustacea, but which must not be regarded as representing the adult condition of any ancestor. The arguments are too many against such a view. A full discussion of this and allied points is reserved for the concluding sections of my studies of Crangon.

egg the better, and hence any modification which would place each organ in its proper place at first, without the aid of later interstitial growth, would be a material gain. In this way the two extremities of the body would come to lie at the two poles[1] of the egg (compare fig. 10 or better, Mayer, ('77, pl. xiii, fig. 15), while the appendages would arise between.

An increase in the amount of food-yolk would result in an increase in the size of the egg, and, supposing the first formed rudiments to retain their relative positions, this would of course widely separate the organs first to appear. Now, we may imagine it would be an economy for the embryo, in its early stages, when the protoplasm was scanty in comparison with the food-yolk, to have its parts near together, and it may be that in this way this strange contraction of the germ has been introduced. In other words the widely-separated, optic lobes and thoracico-abdominal area of stage *A* are an inheritance from a small egged precocious ancestor, while the contraction seen in the later stages is a consequent of the increase in amount of food-yolk.

The manner in which this contraction is produced is almost equally obscure. I regret that I have made no accurate measurements on the living egg which might throw light upon it. For the present I accept the explanation of Mayer ('77, p. 232. "Offenbar kommt eine solche Näherung aller einzelnen Partien auf der Bauchseite des Embryo nur dadurch zu Stande, dass sich die zwischen ihnen liegenden Blastodermzellen contrahiren und sich hiermit zugleich in ein Cylinderepithel umwandeln." This of course involves a corresponding expansion of the blastoderm of the dorsal surface, and Mayer calls for the

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[1] The term pole is used with a mathematical and not with a physiological significance.

testimony of his sections to support his view. He further thinks (p. 228) that the germinal area is formed by a similar contraction and consequent thickening of the cells, but I am confident that in Crangon the germinal area is due largely if not wholly to the mode of formation described above. Whether there be a contraction as well I cannot say.

At stage *C* there appears another structure, the meaning of which I do not understand. On the dorsal surface of the egg, about opposite the mouth in the median line, one sees a patch of about twenty or thirty cells much smaller than those of the surrounding blastoderm. This I have termed a "dorsal organ" for the reason that it agrees with all other structures known by the same name in being unintelligible. In sections (fig. 19) it is seen to be made up of columnar cells with elongate nuclei, the cells being arranged in a radial manner as though an invagination were taking place. The development, so far as my sections show, goes no farther and in the later stages the cells of this region are not distinguishable from those of the surrounding ectoderm. This structure, as shown in fig. 19, at once recalls the early stages of the dorsal organ as described by Bullar ('78) in Cymothoa. It bears less resemblance to the dorsal organs of other forms.

The next stage (*F*) is shown in figs. 17 and 18, which need no extended description. The most prominent features are the beginning of the deposition of pigment, the appearance of the edge of the carapax and the beating of the heart. The deposition of pigment brings plainly into view the compound eyes as well as the median ocellus (*oc*). There also appears in either half of the cephalic ganglion a double pigment spot (*pg*, fig. 17) which so simulates an ocellus that I have been unable to decide whether it were

such or not. The pigment of the compound eye is first deposited in a linear patch (fig. 18, *ey*). In this stage the yolk is much less abundant than in the previous one.

The changes which occur between stages *F* and *G* (fig. 20) are chiefly those of degree. The yolk is less extensive, the edge of the carapax is free all around, the eye has more pigment and pigment spots are visible upon the sides and on the antennulæ. In the abdomen the ganglia are plainly visible (*na*) and the telson (*vide* fig. 22) is bifurcate and armed with the typical seven spines on either half. The anterior end of the intestine terminates in a wide open funnel which spreads to embrace the yolk and the whole tube keeps up a constant peristaltic motion which forces the yolk granules in the funnel-like extremity back and forth with an oscillating motion. The heart beats as rapidly and more vigorously than before. Its general appearance is shown drawn to a larger scale in fig. 21. A detailed description of it will be given later.

Stage *H* (fig. 23) is the young shrimp nearly ready to hatch. The abdomen has now become greatly longer and is wrapped around the body, its tip passing between the eyes to the front of the head. The yolk is greatly reduced, two large lobes of it remaining in an unbroken condition while another portion is being rapidly converted into yolk globules by the waves caused by the peristaltic action of the intestine. The heart is larger and more vigorous than before. It still possesses but two ostia (one on either side) but a new feature is seen in the appearance of bipolar nerve-cells in its walls. I have not been able to trace the origin of these cells. The gills are beginning to bud from the bases of the limbs as small lobes. The mouth-parts (figs. 24, 25, 26) are well shown in the drawings and call for but little comment. The mandible, however, has one feature which should be mentioned. In the

adult Crangon the mandible is bent at right angles and terminates in a toothed occludent surface but is not provided with a palpus. In the embryo at stage *H*, the mandible has much the appearance of the adult (fig. 24) but it possesses, besides, a prolongation from the outer lower angle which I am inclined to regard as a mandibular palpus though in its bifid termination it is unlike any palpus with which I am acquainted. I was unable to ascertain whether it were freely movable upon the mandible or not.

The last figure upon the plate (fig. 27) represents the shrimp after escaping from the egg, a stage which may be designated by the letter *I*. With this the shrimp passes beyond the scope of my inquiries and the figure is introduced so as to connect my series with the later larva of Claus (**'61**). Claus represents a form which he believes to be the young of Crangon; but his figure depicts a more advanced stage than mine for it has an additional pair of thoracic appendages while the caudal fin is formed by the outgrowth of the pleopoda of the penultimate abdominal segment. There are also differences to be noted in the shape of telson and the relative lengths of its marginal spines, the size and development of the antennæ and antennulæ as well as in other points.

To be continued.[1]

[1] The bibliography will be given with a succeeding portion of the present article. The references to it in the text are given in full face type which indicate the date of each article.

EXPLANATION OF PLATES I AND II.

REFERENCE LETTERS.

a	anus.	*l*	labrum.
ab	abdomen.	*m*	mesoderm.
af	abdominal folds.	*mo*	mouth.
b	blastoderm cells.	*mp*	mandibular palp.
bl	blastopore.	*na*	neural rudiments.
c	cerebrum.	*oc*	median ocellus.
ch	chorion.	*og*	optic ganglion.
d	dorsal vessel.	*ol*	optic lobes.
do	dorsal organ.	*os*	ostium of heart.
e	ectoderm.	*p*	proctodeum.
ec	edge of carapax.	*pg*	pigment.
ey	compound eye.	*sg*	supraœsophageal ganglion.
ga	germinal area.	*t*	thorax.
h	hypoblast or entoderm.	*ta*	thoracico-abdominal area.
ht	heart.	*te*	telson.
i	intestine.	*y*	yolk.

The Roman numerals refer to the serial number of the appendages.

Fig. 1. Section of the unsegmented egg of Crangon showing the nucleus and protoplasm in a central position.

Fig. 2. Section of an egg during the second segmentation, passing through one of the dividing cells in which two nuclei are already present.

Fig. 3. Surface view of a stained egg with about sixteen segmentation spheres.

Fig. 4. Section of the egg shown in fig. 3.

Fig. 5. Section of an early stage of the germinal area.

Fig. 6. Section showing the migration of nuclei to one pole (*ga*) of the egg.

Figs. 7 and 8. Surface views of the egg and region of the blastopore. Of these, fig. 8 is the earlier; it was inadvertently turned around, the anterior end being placed towards the bottom of the plate.

Fig. 9. Section through the blastopore, showing the origin of mesoderm and endoderm. The section is obliquely transverse.

Fig. 10. Embryo after the closure of the blastopore and the formation of the optic lobes. Stage *A*. This should be compared with fig. 1, pl. II, of my paper on the development of the compound eye in Whitman's Journal of Morphology, Vol. I.

Fig. 11. Stage *B*. Characterized by the development of the mouth (*m*), antennulæ (*I*) and the abdominal fold (*af*).

Figs. 12 and 13. Side and ventral views of stage *C* in which the antennæ. (*II*) are outlined.

Fig. 14. Ventral view of stage *D*. The mandibles (*III*) are outlined.

Figs. 15 and 16. Ventral and lateral views of stage *E*, characterized by the existence of seven pairs of appendages.

Figs. 17 and 18. Ventral and lateral views of stage *F*.

Fig. 19. "Dorsal organ" of stage C in transverse section.

Fig. 20. Stage *G*, removed from the chorion.

Fig. 21. Surface view of the heart of stage *G* showing the ostium of one side.

Fig. 22. Telson of stage *G*.

Fig. 23. Stage *H;* the embryo is nearly ready to hatch; the gills are budding from the bases of the sixth and seventh pairs of appendages, and nerve cells have made their appearance in the walls of the heart.

Fig. 24. Mandible of stage *H*.

Fig. 25. First maxilla of stage *H*.

Fig. 26. Second maxilla of stage *H*.

Fig. 27. Young shrimp after hatching, taken with a surface net.

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CONVENTIONALISM

IN ANCIENT AMERICAN ART.

BY F. W. PUTNAM.

The study of the ceramic art of ancient America is productive of much that is of importance in showing the connections between the various peoples who have inhabited the country in past times, their points of contact, and the routes of their migrations. It also enables us to trace the development of that innate principle of the human mind which among all nations finds its varied expression in ornament and art. There is now sufficient evidence to show that the artistic powers of man, like the languages, were developed in distinct centres, from primitive forms of expression which, necessarily, had principles in common. This will, probably, account for the close resemblances which occur in the early expressions of art in different and widely separated centres, and the resultant cosmopolitan forms of various objects. Thus it is that we find in the lower stratum of human development many cooking vessels, water jars, dishes and other utensils made of clay,

that are of the same form and style of ornamentation; but after the particular form of vessel desired was attained, and the early methods of ornament by finger marks, indentures, scratches, cross-lines, and the imprint of cord or fabric, had been carried to their full extent, we can easily understand that something higher would follow. This advanced step is represented in various ways by different prehistoric peoples, but it is when this step is taken that the imprint is given to the art of each.

Among other ways, this higher expression seems to be shown in the realistic representation of inanimate and animate objects, often of a mythological or historical character. In course of time, as art attained increased power of expression, it progressed beyond mere realism and led to the representation of an object by certain conventional characters, without that close adherence to nature which was at first necessary to a clear understanding of the idea intended to be conveyed. Thus conventionalism began. Side by side with this conventional representation of objects are found realistic forms,— conservatism, which is such a strong characteristic of primitive peoples, leading to both methods of expression at the same time.

As already stated, it is during this stage of the art of a people that a special imprint is given, and the line of development which follows is so marked that the particular art of one centre of development can be traced as it spreads and infringes upon another. While a comparison of these various forms of art expression may not necessarily prove the routes which different peoples have travelled in their migrations, it does indicate their points of contact, and to this extent it is so important to a proper understanding of their history that it cannot be neglected.

In the course of my studies in this direction, I was led, some years since, to investigate these realistic and con-

ventional forms and I have called attention to some of the interesting features noticed in the pottery from the stone-graves of the Cumberland valley in Tennessee and from the burial mounds of Missouri and Arkansas.[1]

As a knowledge of this conventionalism is important to our studies I have traced it in the art of those American peoples among whom it has had an existence, although, it is proper to add, it was not developed among them all. With the ancient Mexicans, for instance, their higher ceramic art was more symbolical than conventional, using this latter term with the meaning here given to it. The ancient Peruvians, too, west of the region influenced by the Aymaras, or their predecessors in the vicinity of Lake Titicaca, seem to have been lacking in these methods of conventional representation, and their highest art may be called realism, to which is often added the expression of an action. In the region of Lake Titicaca another type of art expression exists, and while our collection from this region is still meagre there is enough to show a remarkable resemblance to those early old-world forms which culminated in the classical type of the Mediterranean peoples.

In the conventionalism represented on the Cumberland valley pottery, the head of a mammal is one of the most instructive studies. There are, however, other forms less marked, which indicate a contact with the Missouri and Arkansas potters, in whose art the fish, the frog, the owl, the human form and the squash, are the most prominent objects conventionalized. In Nicaragua, the principal forms conventionalized are the animal heads on the feet of tri-

[1] Communications on this subject were made to the Boston Society of Natural History in 1879; to the American Association for the Advancement of Science in 1879; to the American Academy of Arts and Sciences in 1882; and in lectures at the Peabody Museum and in other places, since 1878, but the details have not been published. I have, however, long had series arranged in the Peabody Museum at Cambridge to show the several groups of conventionalized forms.

pods, the human face, and the face combined with the serpent, moulded on the burial jars, although other forms are treated in an interesting manner.

THE ANIMAL HEAD ON POTTERY FROM TENNESSEE.

An illustration of conventionalism, as seen in the pottery from the stone-graves of Tennessee, is shown in the figures on Plate I.

Figures 1 and 2 are of a vessel, rudely realistic, representing the head of an animal. As vessels in every way similar to this are found among the Missouri pottery, it is probable that this form had a single origin. The treatment here given to this animal head has resulted in an unsymmetrical vessel of rude form, not at all pleasing to the eye. An attempt to correct this lack of symmetry is shown in figure 4, in which the ears have been pushed back and the eyes forward, while to offset the nose and mouth on the front, a knob, which we may call a tail, has been placed opposite; but still we cannot say that the effect is pleasing, for here we observe the absence of the natural relation of parts without compensation in other ways.

In the next vessel, figure 3, we see a higher expression, and realism has slightly given way to the desire for symmetry. Here we see the effort to make a symmetrical vessel and also to add two handles, while at the same time the character of the animal head is retained. The nose, eyes and ears are represented, on each side of the vessel, in a row from handle to handle.

In figures 5 and 6, the nose and mouth form the central object on one-half of the vessel, with an eye on each side. On the opposite half, the tail and an ear on each side are the balancing features, and a handle is placed in the centre between the eye and ear on each side.

With this arrangement of the parts, conventionalism has full play, and in figures 7 and 8 are seen two vessels on which the nose, eye, ear and tail are rudely represented in the same positions as in the preceding. Several other vessels are of the same character, but slightly modified in the more or less realistic representation of the several parts, until, finally, the climax of conventionalism in this direction is reached in the vessel shown in figure 9, where the nose, tail, eyes and ears are represented by six round knobs of equal size, holding the positions assigned to the several features in the preceding figures.

In this last specimen realistic work has entirely given way to symmetry, and a common cooking pot has become chaste in style as the result of a development of artistic feeling.

All the examples to which I have referred are from the stone-graves in the burial places of a people who must have lived in towns near together in the Cumberland valley. Unfortunately, we cannot ascertain how long it took for this development, but that these burial places contain the dead of many generations there is no doubt.[2]

OTHER FORMS CONVENTIONALIZED.

In the case of the fish, particularly in the pottery from the St. Francis valley in Arkansas, the realistic forms are of the same character as the mammal's head in the preceding figures 1 and 2, from Tennessee, and the line of conventionalism is carried out on similar principles; that is, the

[2]It is important to state that the study of the art of this ancient people is based upon a collection derived from over six thousand of the singular stone-graves in the Cumberland valley, which were opened by myself or by assistants working under my direction. I was in particular aided by the faithful labors of the late Mr. Edwin Curtis, of Nashville, who for several years acted as my principal assistant in the Cumberland valley and in Arkansas. It is also important to state that in all these graves there was not a single object found indicating contact with Europeans.

vessel, first in the form of a fish, gradually loses its piscine shape, and either the dorsal and anal fins alone are left to serve as handles, or the head and tail are reduced to simple knobs for that purpose.

In the case of the frog, also largely used in Missouri and Arkansas art, the realistic representations are common, but in the process of conventionalism the legs of the frog become ridges on the sides of the vessel and serve as handles. It is an interesting fact that there are vessels from Nicaragua which have the same conventional ornaments on their sides; but as I have not seen any intermediate forms between them and the realistic frog, which also occurs in Nicaraguan work, I cannot assert positively that this conventionalized form is here actually derived from the frog, although it seems probable.

In the bird, human and squash forms, particularly prominent in the jars from the Missouri burial mounds, the modifications are principally at the top of the vessel, and all three forms are conventionalized to a simple type, having the appearance of an intermediate form. From a casual examination of the series of Missouri pottery in the Museum, having these forms, it would be easy to conclude that the jars in the shape of women were a development from those of the squash form, were it not that the realistic work in every case preceded the conventional.

THE HUMAN FACE ON POTTERY FROM NICARAGUA.

The many ways of treating the human face as an ornament on ancient pottery from Nicaragua is an interesting study, and its combination with the serpent is a remarkable feature in this old art to which I shall refer on another occasion. For the present only one of the methods is considered, and this is selected on account of its close re-

semblance to the treatment of the animal head on the jars from Tennessee. In fact the underlying principle in both is the same.

Plate II contains figures of the human face as seen on seven small vessels from ancient burial places near together in Nicaragua.

In figure 1, we have a well carved human face. In this effort the potter evidently did his best to make a symmetrical head and the only lack is in the eyes, one of which is apparently represented as closed and the other half closed, or with the upper lid drawn down. The realism is further shown by the stud-like ornaments in the enlarged ear-lobes.

Figure 2 is still realistic in the portions represented, but the mouth is absent, and the nose and eyes are the prominent features, while the ears are rudely done.

In figure 3 the several features are distinctly presented and each one is characteristically represented.

In figure 4 the same method of showing the parts of the face is followed, but from the eyes extend lines representing the eyebrows. This is probably the beginning of the combination of the serpent with the face as shown in another series.

Figure 5 shows all the features, but each is reduced to its characteristic parts.

In figure 6 the eyes and ears are nearly the same as in the preceding, but the nose has become simply a round knob. The mouth has now disappeared in this series of conventionalized forms, and, finally, in figure 7, the nose, eyes and ears are all reduced to simple knobs formed of pinches of clay added to the surface of the jar, thus representing the several features of the face in the same manner as in the jar from Tennessee. Although the ar-

rangement of the parts in the ultimate forms of the two groups is different, the realistic beginnings of the two series are similar, and the method of conventionalization is the same in principle.

THE FISH ON THE FEET OF TRIPODS FROM CHIRIQUI.

The recent acquisition by the Peabody Museum of a large collection of pottery from the ancient graves in Chiriqui, Panama, has drawn my attention again to the conventional representation of the fish upon the feet of the tripods, where the whole purpose to be served seems to be simply and purely ornamental. This is the more probable from the fact that other animals, and even the human form, are represented on other tripods from the same graves. I have selected the fish for illustration, as the series belonging to this group is larger and more perfect than the others.

In the two figures represented on Plate III, the shape of these tripods is shown. In one, the legs are plain, in the other, they are ornamented in such a manner as to give several of the special features of a fish. On each of the feet, in the latter, we see the projecting and wide mouth, the eyes, the pectoral fins, and a forked tail. The space where the dorsal fins naturally would be placed was cut away before the vessel was baked, and through this slit can be seen the movable ball of clay with which these hollow legs are generally provided.

In not a single instance is there an attempt to represent the anal fin, which would have its natural position on the opposite, or inner side of the foot of the vessel. Its absence can be taken as another evidence that this treatment is purely for ornament, and it probably owed its origin to the fact that the potter, realizing the adaptability of the

fish to his purposes, gave way to his fancy and added to his art that of the sculptor.

On Plates IV-VII, are shown this series of feet from tripods, illustrating the different ways in which this primitive conception became conventionalized by the prehistoric people of Chiriqui, who carved in stone as well as in clay, and who were also remarkable for their work in copper and gold, in which materials their realistic and conventional art followed a course similar to that shown in their pottery.

Plate IV. Figure 1 is a plain foot of a tripod and shows the adaptability of this form to the essential external characters of a fish.

Figure 2 is a rudely realistic representation of a fish, with mouth, eyes, two dorsal fins, and the pectoral and ventral fins on the sides. All are in approximately natural positions, while the caudal fin is represented as an horizontal instead of a vertical termination of the body. The manner in which the several features are here shown must be kept in mind as we follow out the series, particularly the central indentures in the small oval pieces of clay representing the eyes, and the incised lines running from the body on the bits of clay which indicate the dorsal and paired fins, although these details are sometimes omitted.

In figure 3 the ventral fins are not represented, while the pectoral, dorsal, and caudal fins are shown nearly as in figure 2, except that the pectorals are placed close to the mouth. In the raised bands representing the upper jaw, the outline of the mouth is retained as in figure 2; but here artistic license comes into play, and the lower jaw is brought up to a level with the upper, and as the whole space allowed for representing the head is thus disposed of, the eyes are placed forward of the mouth, at a point where this foot joins the body of the vessel.

The Chevron Ornament. Plate V. Figures 1, 2 and 3, are from one tripod, and this is the only instance in the series where the three feet of a vessel are not essentially the same, and even here there is a general similarity though the details vary. It will be noticed that in all three, the caudal fin is represented in its natural, or vertical position, the rays being indicated by the notches cut across the edge of the compressed terminal portion of the foot which is turned forward.

In figure 1 the head of the fish is triangular, and terminates in a truncated nose, on each side of which is the mouth, shown by incised lines. The eyes are two small round bits of clay without the usual line cut across them. Just back of these is the dorsal fin, and on each side of the long central opening of the foot are the pectoral fins, below which the artist has cut two rows of chevron-like lines, which, possibly, may have been suggested by bands of color upon the sides of many tropical fishes.

In figure 2 there is a slight change from figure 1 in the shape of the head, but the eyes and dorsal fin are in nearly the same relative positions, although varying in their details. The pectoral fins are absent, but the ventrals are represented although not directly opposite each other, and the bands of chevron-like lines are placed between these fins and the eyes.

In figure 3 there is a marked difference in the manner of representing the mouth. Curved lines are cut in a broad band of clay. Back of these is an enlarged dorsal, on each side of which are the pectoral fins, the eyes being omitted. Below, the ventral fins are introduced, and between them and the pectoral fins are the chevron bands nearly the same as in figure 2.

The foot from another tripod, given as figure 4, exhibits a result of this chevron ornament. In this all parts of the

fish are omitted except the pectoral and ventral fins which are placed on each side of the long opening in the foot, and the dorsal fin which is placed over it. Pendent from the knob representing the dorsal fin are the two chevron bands. In this conventionalized form a simplicity in ornament has been reached which is far more pleasing to the eye than are the crude and crowded expressions in the preceding figures.

As the two tripods with this chevron ornament are from graves near together, they may represent the successive efforts of the potter struggling to give expression to artistic feelings.

The Pectoral and Ventral Fins. Plate V. Figure 5 is another instance where an addition has been made to the characters of the fish. In this case the head is expressed by the nose and eyes which are carved in relief upon a triangular piece of clay added to the upper part of the foot. On each side of this piece of clay are the pectoral fins, while the ventral fins are united by a band of clay crossing the opening in the foot. On this band are several slight v-shaped indentures. As in the last figure and in the following, there is no attempt to represent the caudal fin.

A resultant form from the last is shown in figure 6. In this the general curved outline of the head, or mouth, of the fish is retained as the upper border of the foot, while the pectoral and ventral fins are expressed by rather large pieces of clay with deep notches.

Two more lines are to be traced in this conventionalism of the fish. In one the mouth is the essential feature and in the other the dorsal fin. They both start from a realistic form like fig. 2, Pl. IV, but they soon diverge and the results are decidedly different.

The Mouth. Plate VI. In figure 1, as will be seen, the mouth, with its pointed jaws, is the essential feature. The pectoral fins are at the angles of the mouth. The eyes are in their normal position. The dorsal and ventral fins are absent. The caudal is represented as in fig. 2, Pl. IV.

In figure 2 the pointed nose and mouth are prominent features. The pectoral and caudal fins are not striated. The eyes are similar to those in figure 1.

In figure 3 the deep lines cut in the bands of clay forming the jaws, and others between them representing the teeth, are evidence that the thoughts of the artist were concentrated upon representing the mouth of a fish. The pointed nose in the previous figure here gives way to the forced expression of a mouth, and is placed on the under jaw, with a license similar to that used in representing the eyes in fig. 3, Pl. IV. The pectoral fins are in the same position as in the two preceding figures, while the ventral fins are copied from the realistic form. The caudal fin has entirely given way to a rounded knob.

In figure 4 there is a raised pointed portion over the opening in the foot. On this part a deep line is cut corresponding to the line which gives emphasis to the jaw in the preceding figure. The striated patch of clay on each side below the angle of the mouth represents the pectoral fins. All other parts of the fish are wanting.

In figure 5 the pointed jaw alone is preserved in the mass of clay placed above the opening in the foot; and, finally, in figure 6, the climax in this line of conventionalism is reached by cutting two sets of oblique lines on the surface of the foot itself.

The Dorsal Fin. Plate VII. In the final series, the prominence which the dorsal fin is to have is exemplified by figure 1. In this, the mouth, eyes and pectoral fins

PLATE I.

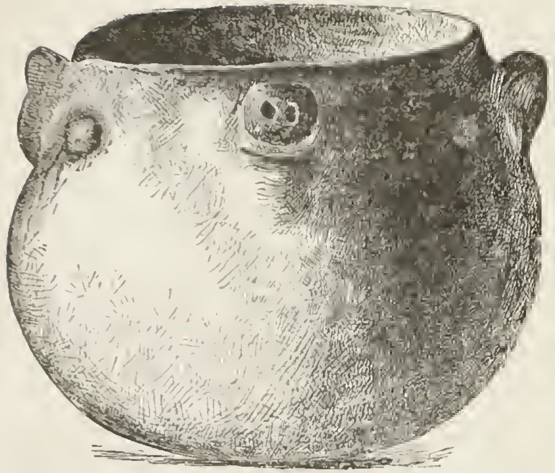


Fig. 1.

Fig. 2.

Fig. 5.

Fig. 7.

Fig. 9.

Fig. 3.

Fig. 4.

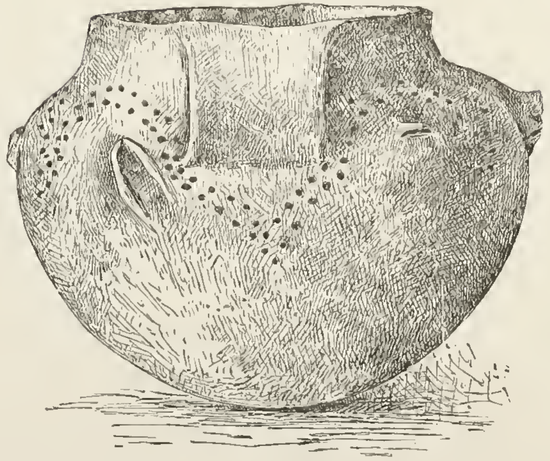


Fig. 6.

Fig. 8.

THE ANIMAL HEAD ON ANCIENT POTTERY FROM STONE-GRAVES IN TENNESSEE.

PLATE II.

Fig. 1.

Fig. 2.

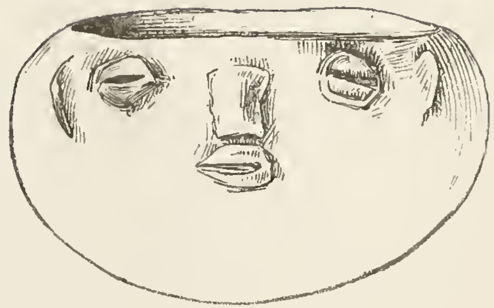


Fig. 3.

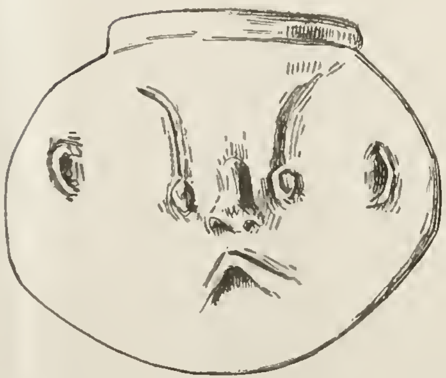


Fig. 4.

Fig. 5.

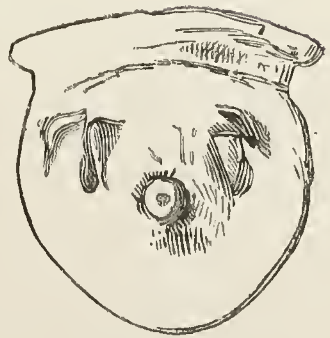
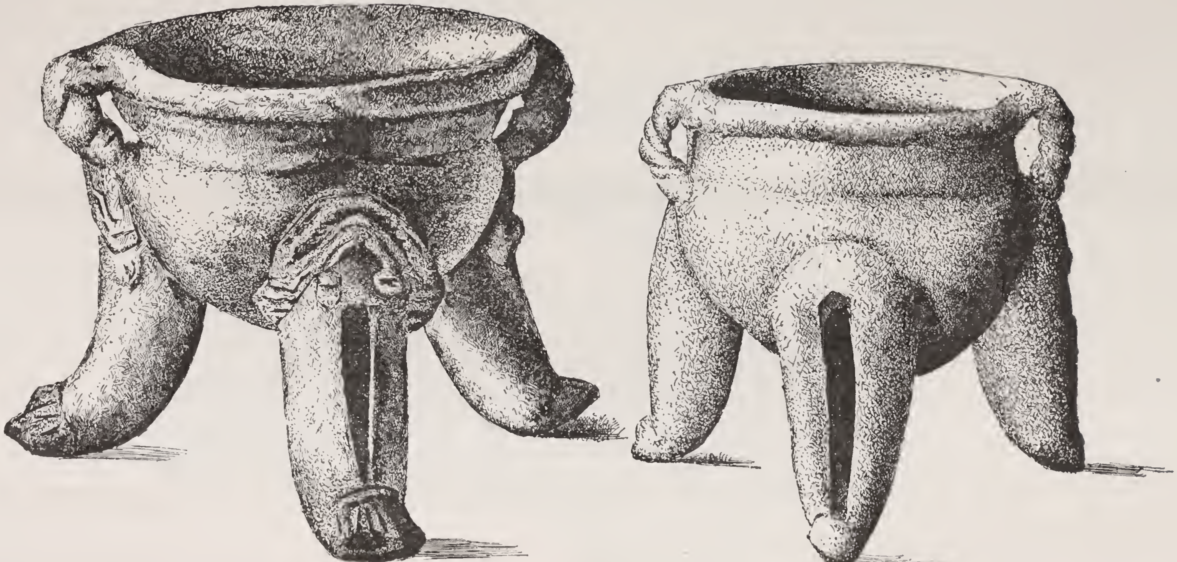


Fig. 6.

Fig. 7.

THE HUMAN FACE ON POTTERY FROM NICARAGUA.

PLATE III.



TRIPODS FROM CHIRIQUI.

PLATE IV.

Fig. 1.

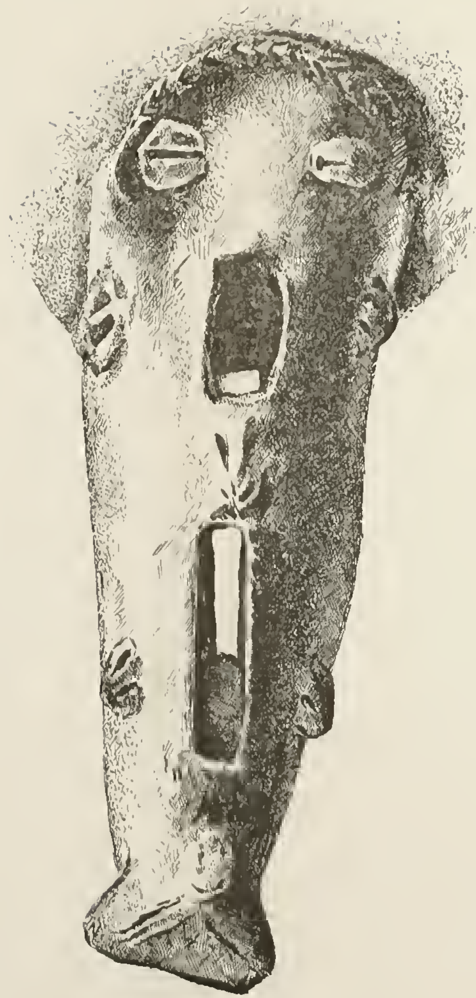


Fig. 2.

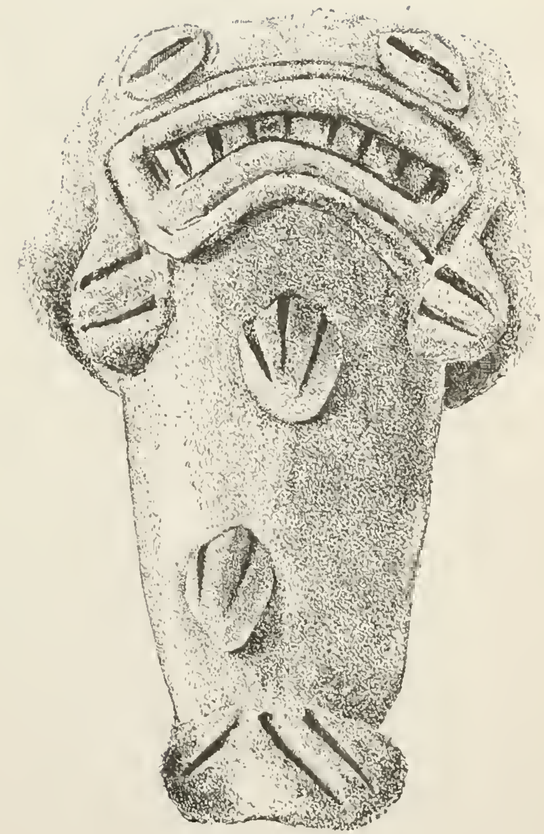


Fig. 3.

THE FISH ON THE FEET OF TRIPODS FROM CHIRIQUI.

PLATE V.

Fig. 1.

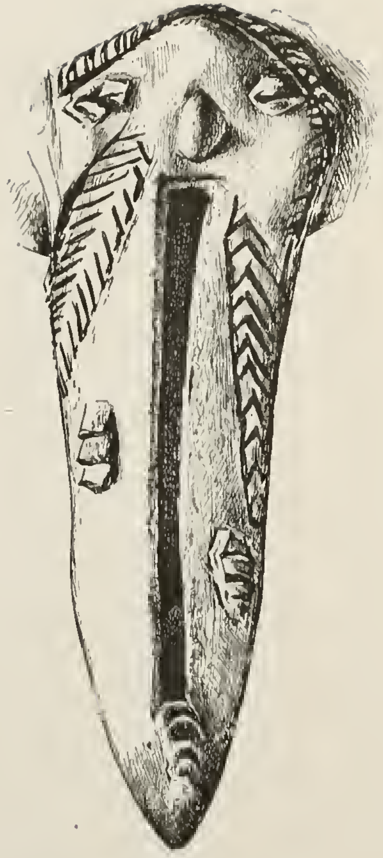


Fig. 2.

Fig. 3.

Fig 4.

Fig. 5.

Fig. 6.

—Figs. 1-4. The Chevron Ornament.—

—Figs. 5-6. The Pectoral and Ventral Fins.—

THE FISH ON THE FEET OF TRIPODS FROM CHIRIQUI.

PLATE VI.

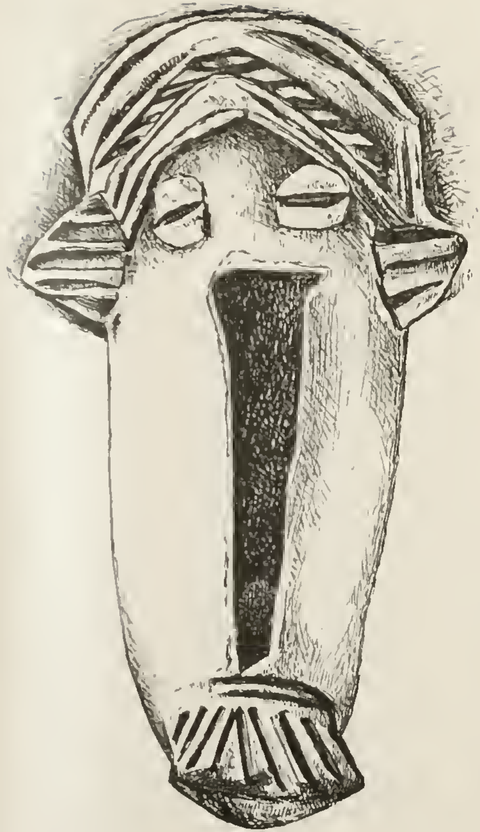


FIG. 1.

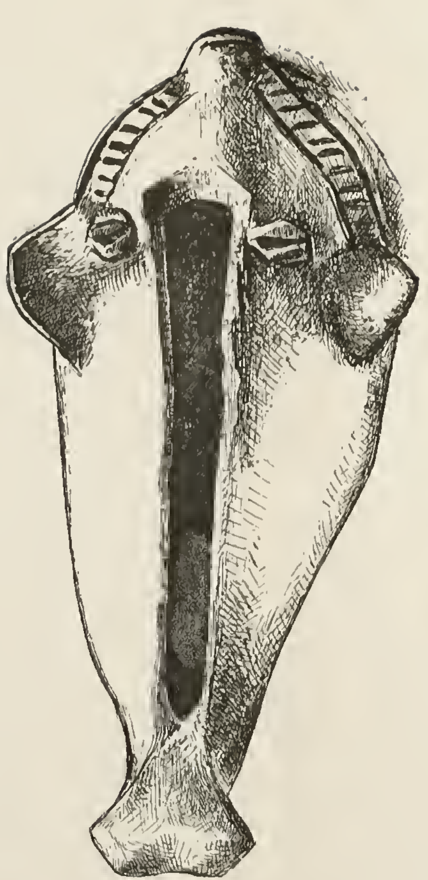


FIG. 2.

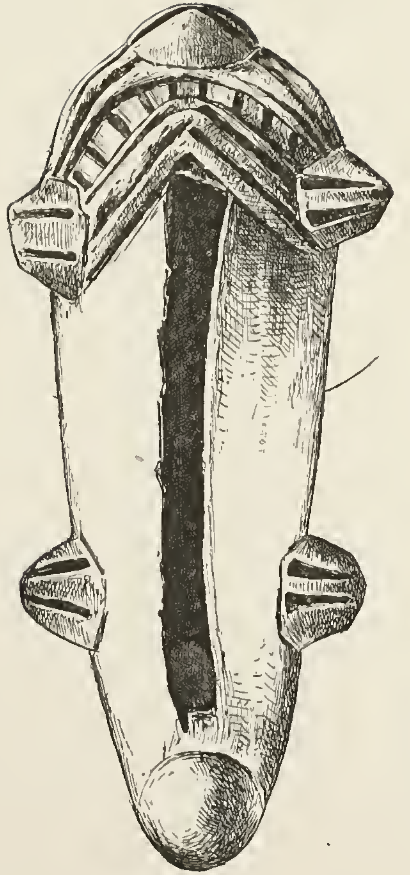


FIG. 3.

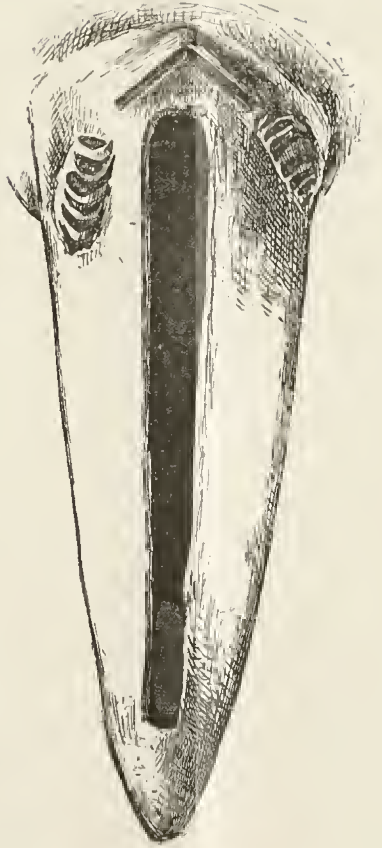


FIG. 4.

FIG. 5.

FIG. 6.

THE FISH ON THE FEET OF TRIPODS FROM CHIRIQUI.

—The Mouth.—

PLATE VII.

Fig. 1.

Fig. 2.

Fig. 3.

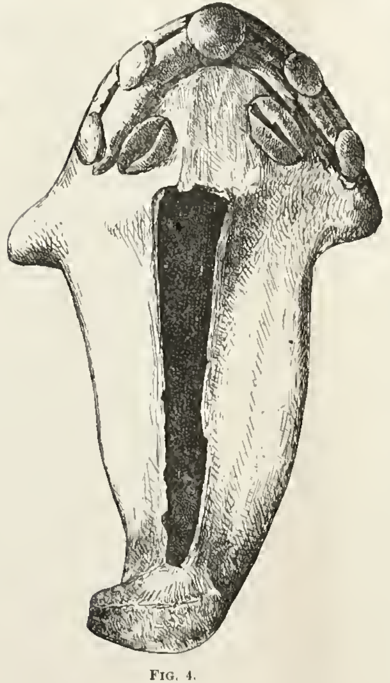


Fig. 4.

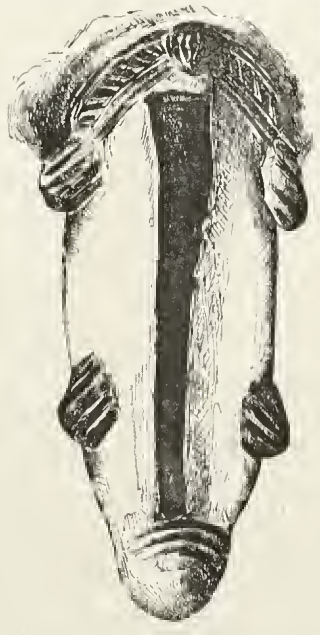


Fig. 5.

Fig. 6.

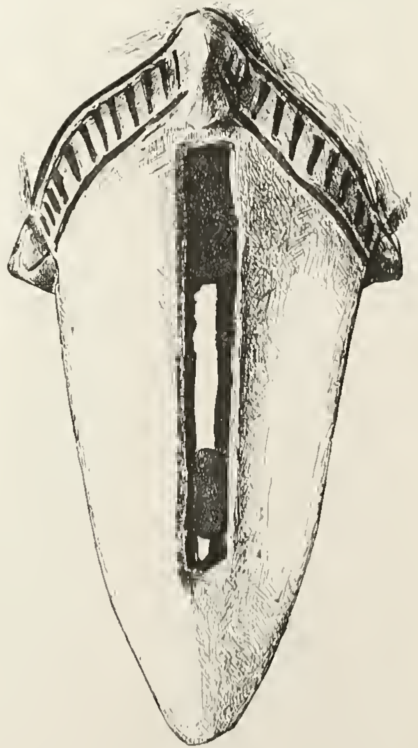


Fig. 7.

Fig. 8.

Fig. 9.

THE FISH ON THE FEET OF TRIPODS FROM CHIRIQUI.

—The Dorsal Fin.—

are all prominent, realistic features, and the dorsal fin is conspicuous by its size and position forward of the eyes.

In figures 2 and 3, the several parts of the head, while rudely done, are expressive, and the dorsal fin placed between the eyes in both is a prominent feature. In figure 3, the teeth are represented by bands passing from jaw to jaw.

In figure 4 these bands become small rounded masses, while a larger one in the centre represents the dorsal fin, as it holds the same position as a striated knob in the following figure.

In figure 5 the mouth and teeth are represented by cut lines, and the ventral, as well as the pectoral fins, are shown somewhat as in fig. 3 of the preceding plate.

In figure 6 the pectoral fins are more closely united to the mouth than in the last, and the dorsal fin is a small striated cone in the centre of the raised lines forming the mouth.

The next step is shown in figure 7, where the pectoral and dorsal fins are represented by three small cones, between which are incised lines for the mouth and teeth.

In figure 8 a deep notch is cut on the upper part of the foot, defining the mouth of the fish under the raised knob representing the dorsal fin, on each side of which are two slight knobs for pectoral fins.

In figure 9 all the parts have been eliminated except the dorsal fin, or the round striated knob above the opening in the foot. On one of the feet of the same tripod the incised lines on the knob are omitted, and in this we find the conventionalized fish reduced to its simplest form,—which may be represented by my period.

A FEW ADDITIONAL NOTES CONCERNING INDIAN GAMES.

BY ANDREW McFARLAND DAVIS.

In the seventeenth volume of the Bulletin of the Essex Institute, beginning page 89, I furnished a communication concerning the character and distribution of the games indulged in by the Indians of North America during historic times. In that communication I cited authorities which covered, in geographical extent, the entire territory of the United States. These citations were, however, fuller and more exhaustive in some localities than in others. It will increase the bibliographical value of the research if I add to what has already been published a few references which cover the ground more completely. It will be observed that some of these contain new facts, but even where this is not the case, the citations will not be without value. In presenting these references, I shall follow the same general classification of games as before.

LACROSSE.

My former paper was separately printed and a few copies were distributed among persons who were presumed to be interested in the subject. Mr. F. P. Deering, of San Francisco, in his acknowledgment of the receipt of a copy which I sent him, communicated the following interesting information :—

"I have delayed acknowledging your kindness in sending a copy [of Indian Games] to me, to get some facts about the Oregon game of Koho played by the Indians of that section. Mr. Simpson, a friend of mine,—a lawyer here,—passed much of his youth on an Indian reservation in Oregon, of which his father was the head. He tells me that the favorite game with the various tribes stationed there, was one which was played sometimes by members of the same tribe, and at others by different tribes, and called as if spelled k-o-h-o. A wooden ball whittled out of the knot of some tree, maple I think, was placed in the ground midway between the goals which were usually three-quarters of a mile apart. A hole about as large as a man's hat was dug in the earth and lightly filled with dust and leaves. In this the ball was placed. The chiefs, each with one koho stick, about as long as a walking-cane, widened to two or three inches perhaps, at the end, and bent upward, stood on either side of the hole; and, at a given signal, struggled to get possession of the ball with their sticks. The men on either side were at liberty to take what stations they pleased anywhere in the field. The goals were not like those in lacrosse, but were arbitrary lines, the length of the whole end of the field, and across one of these lines the ball had to be driven. The game, as it was described to me, was extremely rough; tripping, pushing and catching men by the legs with the koho stick being permitted. Striking one another with the stick was even resorted to, although the last was supposed to be forbidden. The players were often severely hurt, but my informant knew of no case where any one was killed, or where bones were broken. He tells me of different instances where the heat of the game led to fights among individual players and says that on one occasion when the game was between different tribes, and the losing party be-

gan to attack the winners with their kohoes,[1] the spectators, sympathizing with the winners, fired rifles at the losers.

Gambling was one of the features of the contest, just as with the games you describe, and the participants and lookers-on often wagered every stitch of clothing they had on. So far as costume for the game is concerned, I could not learn that any special preparation was made."

In the description of lacrosse as played on the Pacific coast, which was quoted in the former article, the bat was described as "constructed of a long, slender stick, bent double and bound together, leaving a circular hoop at the extremity, across which is woven a coarse meshwork of strings." In the game of koho, it will be noticed that this form of bat is changed, and the consequent modifications of the game, from inability to strike sharply with the cross, do not appear. We have a game which closely approximates lacrosse as described in early times in the east. The koho stick resembles the "curved wooden head" of which Morgan gives an account, but which, so far as my observations go, is mentioned by no other writer. The method of opening the game seems to be

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[1] The mention of this word in the English plural naturally brings to mind the fact that the town of Cohoes in New York bears an Indian name, apparently pronounced like the name given the bats in the Oregon game. Morgan, in his "League of the Iroquois," p. 474, gives the Mohawk name for Cohoes as Ga-ha-oose, and defines its meaning to be "shipwrecked canoe." In "A General History of Connecticut," etc., by a gentleman of the province, London, 1781, reprinted with supplement, New Haven, 1829, the author (said to be Rev. Samuel Peters) says, p. 110, "In the Connecticut river there are three great bendings, called Cohosses, about 100 miles asunder." This is evidently the same word applied through its descriptive force, to places dangerous for navigation on each of the rivers. A coincidence of the use of the same word in dialects used by tribes so widely separated as those living in the valleys of the Mohawk and Connecticut, and those living in the valley of the Columbia, is not impossible but is not probable.

In a dictionary of the Niskwalli, by George Gibbs, Contributions to North American Ethnology, Vol. I, p. 292, "ka-hōs, ka-ho sin, a club," is given. Dr. Trumbull, whom I consulted, called my attention to the word "ko-ko, to knock," given in Gibbs' dictionary of Chinook Jargon. See Dr. Shea's Library of American Linguistics, No. XII.

entirely original. It had this advantage over the ordinary plan of starting through the agency of an umpire or some disinterested party, that no favors could be shown. By means of this description—if doubts existed before—we are enabled to identify, beyond cavil, the game of lacrosse as one of the amusements indulged in by our Pacific coast Indians.

William Strachey[2] contributes an interesting account of games in Virginia in the beginning of the seventeenth century. He refers to ball playing as follows: "A kynd of exercise they have amongst them much like that which boyes call bandy[3] in English, and maye be an auncient game, as it seemeth in Virgill; for when Æneas came into Italy at his marriage with Lavinia, King Latinus' daughter, yt is said that the Troyans taught the Latins scipping and frisking at the ball."

The comparison, by Strachey, of the ball game played by the Virginian Indians to bandy, favors the inference that the game was rather hockey than lacrosse. Capt. James Smith describes such a game among the Wyandots. "They commonly struck the ball with a crooked stick," is his language.[4] It is nevertheless quite probable that Strachey's ball game was lacrosse. Our previous examination of French authors has shown that they almost invariably compare lacrosse with tennis. If the game which Strachey saw was lacrosse, his comparison to bandy

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[2] The First Booke of the Historie of Travaile into Virginia Britannia, etc., by William Strachey. Edited by R. H. Major, London, for the Hakluyt Society, 1849, p. 77.

[3] Bandy ball is described by Strutt. In the Chatto & Windus Edition, London, 1876, this description appears, p. 170. Accompanying it is an illustration representing "*Bandy-Ball, XIV Century.*" In the scene portrayed by the artist, two players are seen with hockey sticks in their hands. One is about to strike the ball which lies upon the ground at his feet.

[4] An Account of the Remarkable Occurrences in the Life and Travels of Col. James Smith, during his Captivity with the Indians in the years 1755-1759. Cincinnati, 1870, p. 77.

would have been much more justifiable than the comparison to tennis by the French writers.

Ball play seems to be associated with the legends of the Indians. Elias Johnson,[5] himself an Indian, tells about a tradition of a little old man who frequently presented himself among the ball players. His presence in no way affected the game, but he was afflicted with innumerable ailings and to a kindly woman who received him in her hut, he successively disclosed the treatment which would cure each of his complaints, until he reached consumption, which he pronounced incurable. Whether the use of the game by the medicine men, as a cure-all, is based on the tradition, or the tradition on the use, does not appear, but the connection is evident.

In 1768, J. Long[6] arrived at Montreal. He spent many years among the Indians of Canada and the northwest. Part of the time he was engaged in mercantile pursuits, and during a portion of the Revolutionary War he coöperated with the Indians engaged on the English side. He describes lacrosse. It is not clear among what tribes he means that he saw the game played, but I infer that it was among the Chippewas. The ball was of stuffed deer-skin. The rackets were about two feet long and were laced at the end. The ball was to be struck "into a goal, at the distance of about four hundred yards, at the extremity of which are placed two high poles, about the width of a wicket from each other; the victory consists in driving the ball between the poles." He also records the good humor which prevailed during the games, even in case of serious hurt.

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[5] Legends, Traditions and Laws of the Iroquois, etc., by Elias Johnson, a native Tuscarora chief. Lockport, 1881, p. 58.

[6] Voyages and Travels of an Indian Interpreter, etc., by J. Long. London, 1791.

Although Long mentions but one goal, it is evidentt h a he is describing the ordinary game. His account covers merely the action of one side and omits all mention of opposition, except that the play of the parties was said to be to intercept each other. Apparently both sides were intent upon driving the ball into the same goal; but the confusion of the account is removed if we interpret it as an attempt to describe the game as ordinarily played, making allowances for the inexact way in which a man whose life has been mainly spent in the woods, would naturally express himself when committing his thoughts to paper.[7]

PLATTER OR DICE.

The quaint descriptions of dice, foot-ball, etc., quoted from the pages of Ogilby,[8] in the former article were taken by the compiler from Wood's "New England's Prospect."[9] Governor Hutchinson[10] availed himself of the same work in describing games among the Massachusetts Indians. Roger Williams in his "Key into the Language, etc.,"[11] furnishes another account of these games, somewhat similar in its curious style of language and containing an interest-

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[7] Major Z. M. Pike in "An Account of Expedition to the Sources of the Mississippi," Philadelphia, 1810, describes a game of cross between the Sioux, and the Puants and Reynards, Vol. I, p. 100.

[8] America, being an Accurate Description of the New World, etc. Collected and translated by John Ogilby, London, 1670.

[9] William Wood's New England's Prospect. London, 1634. Reprinted by the Prince Society, Boston, 1865. See p. 96.

[10] The History of the Colony of Massachusetts Bay, etc., by Mr. Hutchinson, Lieutenant-Governor, etc. The Second Edition, London, 1765, p. 470.

[11] A Key into the Language of America, etc., together with brief Observations of the Customes, Manners, etc., by Roger Williams of Providence in New England. London, 1643. Reprinted in the collections of the Massachusetts Historical Society for the year 1794. Vol. III, p. 234. In this reprint the Key is somewhat abridged. Reprinted in full in the Collections of the Rhode Island Historical Society, Vol. I, Providence, 1827. Reprinted also in full by the Narragansett Club. in Vol. I of their publications, Providence, 1866. This edition was published under the supervision of Dr. J. Hammond Trumbull, who carefully eliminated the errors of the other reprints and added greatly to the value of the work by copious annotat ions.

ing description of the assembling of the Indians in their play houses. He divides the games into two sorts, private and public. "Their publique games," he says, "are solemnized with the meeting of hundreds, sometimes thousands, and consist of many varieties, none of which I durst ever be present at that I might not countenance and partake of their folly after I once saw the evill of them." Under the name, "Puttuckquapuonck, a playing arbour," he describes their play house as follows: "This Arbour or Play house is made of long poles set in the earth, four square, sixteen or twentie feet high, on which they hang great store of their stringed money, have great stakings, towne against towne, and two chosen out of the rest by course to play the Game at this kind of Dice, in the midst of all their abettors, with great shouting and solemnity." "This kind of dice," he had already described as "plumb-stones painted, which they cast in a tray with a mighty noise and sweating."

In a note to the edition of the "Key" published by the Narragansett Club, Dr. Trumbull, the editor, says: "The Abnakis (Râle, s. v. *Jouer*) played this game with eight such dice or counters. When the black and white turned up 4 and 4, or 5 and 3, the player made no count; for 6 and 2, he counted four, for 7 and 1, ten, and when all eight were of one color, twenty."

Major Stephen H. Long translates the Omaha word for dice, as Dorsey does "Plum-shooting," and adds that the game was played with sticks as counters.[11a]

Long,[12] the Indian interpreter, describes a form of dice, under the name *Athtergain*, which was played with black

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[11a] Account of an Expedition from Pittsburgh to the Rocky Mountains, etc. Vol. I, p. 215. For this reference and for other suggestions, I am indebted to the kindness of Mr. Lucien Carr, Assistant Curator Peabody Museum. The paper of Dorsey is referred to in Note 65, former paper.

[12] Voyages and Travels of an Indian Interpreter, etc. London, 1791, p. 52.

and white beans, one of which had small spots and was called the king. The beans, he says, "are put into a shallow, wooden bowl, and shaken alternately by each party, who sit on the ground opposite to one another; whoever is dexterous enough to make the spotted bean jump out of the bowl, receives of the adverse party as many beans as there are spots. The beans do not count for any thing."

J. G. Kohl[13] describes a form of platter or dice, which he encountered in his travels about Lake Superior, in which figures resembling chess-men were used. These were carved neatly out of bone, wood or plum-stones, and represented different objects, such as a fish, a hand, a door, a man, a canoe, a half-moon, etc. The figured pieces could stand upright. Associated with them were the ordinary plum-stones, plain one side and red the other. The figures and plum-stones were placed in a bowl which was then twirled, the bowl itself having first been placed in a hole in the ground prepared for the purpose. The position of the figures and the sides exposed by the dice after the twirl determined the count.

Among the Sioux the game of dice was made use of to effect a distribution of the property of deceased Indians. Some person was selected to represent the ghost, and the games were conducted in the lodge of the deceased. The stakes apparently were only put up by the ghost. The players participated in the game with the ghost, one at a time. If they won, they took their winnings. If they lost, they went away. This curious custom is fully described in a paper on the Mortuary Customs of the North American Indians by H. C. Yarrow.[14] The author treats of games as "an adjunct part of funeral rites, which con-

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[13] Kitchi-Gami, Wanderings Round Lake Superior, by J. G. Kohl. London, 1860, p. 82.

[14] First Annual Report of the Bureau of Ethnology, Smithsonian, 1881, p. 195.

sist in gambling for the possession of the property of the defunct." This paper is illustrated with a picture of the game of plum-stones. Illustrations, showing the marks on the plum-stones and the winning throws, are also given.

STRAW OR INDIAN CARDS.

The first game described by Roger Williams in his Chapter on Gaming[15] is "A Game like unto the English Cards, yet, instead of Cards, they play with strong Rushes." In his vocabulary he gives "Akésuog: they are at cards, or telling of Rushes; Pissinnéganash: their playing Rushes; Ntakèsemin: I am a telling, or counting; for their play is a kind of Arithmatick." Dr. Trumbull calls attention in a note, in his edition, to the fact that Rasle gives as a meaning for the word which in his vocabulary corresponds to Pissinnéganash, "*les pailles avec quoi on joue.*"

Strachey[16] found this game among the Indians in Virginia. He describes it as follows: "Dice play, or cardes, or lotts, they know not, how be it they use a game upon rushes much like primero,[17] wherein they card and discard and lay a stake or two, and so win and loose. They will play at this for their bowes and arrowes, their copper beads, hatchets, and their leather coats."

Robert Beverley,[18] a native of Virginia, published anonymously, in 1705, a History of Virginia, which was trans-

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[15] Chapter XXVIII, of the Key to the Language of America.

[16] Strachey's Book of Travaile, p. 65.

[17] *Primero* is described in Strutt, p. 433, as "among the most ancient games of cards known to have been played in England." It is useless to attempt to derive any information as to the game "upon russhes" from Strutt's rules for *Primero*. The "card and discard" upon which Strachey perhaps predicated the similarity of the games, evidently referred to the system of counting followed in the game of "straws," in which the players told off the straws in bundles of ten.

[18] The edition which I have consulted was a French translation: Histoire de la Virginie, etc., par D. S. Natif et Habitant du Pays. Traduit de l'Anglois et enrichie de figures. Amsterdam, 1712. See p. 302.

lated into French and afterwards published at Amsterdam and at Orleans. He says the natives engaged in "certain violent plays, which they enjoy much and in which they run and leap upon each other."

"There is one in particular, which pleases them much, and in which they take handfuls of sticks, or pieces of stiff straw, which they count as quickly as the eye can move, with marvellous dexterity." Beverley seems to have comprehended the fact that the separation of the straws into piles was connected with the process of counting, but he has not ventured to describe the details of the game.[19]

It is easy to recognize in these various descriptions, the game which the French writers invariably call "*Pailles*", and it is curious to note that the features of the game which evidently made the most vivid impression upon these authors were described in substantially the same language by other writers, in separate localities and at different periods of time. We have a new authority for the statement that the game is a "kind of Arithmatick", a fresh comparison with cards,[20] and additional testimony to the marvellous rapidity with which the players counted.

CHUNKEE OR HOOP AND POLE.

Laudonnière,[21] describes a curious alley near an Indian village which was found by a French expedition, in the middle of the sixteenth century. He says: "There is at the coming foith of the village a great alley about three

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[19] I am indebted to Dr. Trumbull for information that a MS. Illinois Dictionary (probably compiled by Gravier, about 1700) gives many of the terms used in the games of straws and dice.

In his edition of Roger Williams' Key he has pointed out that the literal meaning of the Massachusetts and Narragansett word "akésuog" for playing "at cards or telling of rushes" is "they are counting."

[20] In the Illustrated Catalogue of the Smithsonian Collection from the Pueblos, No. 69, 340, is given to —— "Wooden cards for betting game."

[21] Hakluyt's Collection of Early Voyages, Vol. III, p. 415.

or four hundred paces long, which is covered on both sides with great trees." Is it not probable that this refers to a plot of ground prepared for the game of chunkee? In the previous paper I have quoted a number of descriptions of chunkee grounds which resemble this. In these descriptions the grounds were spoken of as, "a fine level square;" "a square piece ground well cleaned and fine sand is strewed over it;" "an alley of about two hundred feet in length," etc. No chunkee ground is described as being four hundred paces in length, but distances are not, as a rule, accurately stated by early writers. It seems to me probable therefore that Laudonnière's "great alley" was the village chunkee ground.

Major Stephen H. Long[22] describes dice, and hoop and stick among the Omahas, in the account which he published of his expedition to the Rocky Mountains. He says hoop and pole was played among the Pawnees on a smooth beaten path. The pole had a crook at the end and the aim of the player was to slide the pole after the hoop so that when it fell the hoop should be caught by the hook.

Major Pike,[23] in 1810, published an account of his expedition to New Mexico and of his exploration of the sources of the Mississippi. He mentions two forms of hoop and pole among the Pawnees which differ from any that have been described. In the first a small leather ring was held by thongs within a larger circle, the outer being four feet in diameter. The attempt was made to check the hoop while it was in motion and pierce the central ring with a

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[22]Account of an Expedition from Pittsburgh to the Rocky Mountains, etc., under command of Stephen H. Long. Philadelphia, 1823. Vol. I, p. 444.

[23]Pike's New Mexico, etc., was published in 1810. It was translated into French and published at Paris in 1812, under title Voyage au Nouveau-Mexique, etc., par le Major Z. M. Pike.—See Vol. II. p. 278 of translation, where the game of "Plate, of which many travellers have written" is also mentioned. In the original, see part II, pp. 15 and 16. The third game is here called "La Platte."

pole which was six feet in length. In the second form the ring was four inches in diameter. The pole was a small stick with hooks on it. The ring was to be picked up with the stick, and the points now depended on the position of the hook in which the ring stopped.

H. M. Brackenridge[24] describes hoop and pole as played at the Arikara village on "a level piece of ground appropriated for the purpose and beaten by frequent use." He also mentions the second form of the game which Pike described. "Instead of poles they have short pieces of wood, with barbs at one end and a cross piece at the other, held in the middle with one hand; but instead of the hoop before mentioned, they throw a small ring, and endeavor to put the point of the barb through it."[25]

The seventh volume of the Report upon United States Geographical Surveys contains a paper on perforated stones, by Mr. F. W. Putnam, Curator of the Peabody Museum. A great many stones of this kind have been found in southern California, on the mainland and islands. Mr. Putnam shows that similar stones have been used elsewhere as hammer-stones, weights for digging-sticks, club-heads, net-sinkers and as spindle-whorls, and he infers the probable use in that region, of the better class of these perforated stones, as club-heads. Since the publication of that paper he has secured and now has, at the Peabody Museum, specimens of such club heads mounted on wooden handles, which came from a cave in southern California.

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[24] Journal of a Voyage up the river Missouri, etc., by H. M. Brackenridge, Baltimore, 1816, pp. 158, 159.

[25] John T. Irving describes the principal game of the Pawnees as one in which a barbed javelin was hurled at a ring four inches in diameter, while the ring was in rapid motion along the surface of the ground. "The javelin is filled with barbs nearly the whole length, so that when it has once passed partly through the ring it cannot slip back. This is done to ascertain how far it went before it struck the edges of the ring, and the farther the cast the more it counts in favor of the one who hurled it." Indian Sketches, Philadelphia, 1835, Vol. II, p. 142, note.

On the other hand, Mr. H. W. Henshaw of the Bureau of Ethnology, Smithsonian Institution, writes me that in 1884 he obtained from the Santa Barbara Indians some interesting points concerning perforated stones from California. He is now preparing a paper on the subject which will be published at an early day. In this paper will be embodied in substance the statement that he "obtained evidence directly from Indians, showing that formerly these perforated stones were largely used in two ways: first, as weights and digging-sticks; second, in playing a game which answers in all essentials to the game of 'chungke.'" This game was described in the former paper in widely separated localities and in various forms. It is not strange, therefore, that evidence has been discovered that it was played by the Indians of southern California.

In the History of Georgia, Charles C. Jones, jr.,[25a] describes the old chunkee grounds of that region, and the chunkee stones. He says, "No longer is this famous game played within the limits of Florida of the olden time."

OTHER ATHLETIC GAMES.

Le Moyne,[26] an artist who accompanied Laudonnière in his expedition to Florida in 1564, describes a game similar to one which was quoted in the former paper from Lafitau. He says:—"They also play a game of ball as

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[25a] The History of Georgia, by Charles C. Jones, jr., LL.D., Boston. 1883, p. 27. The description of chunkee stones, etc., from Jones, and the description of a ball-game played with "curiously carved spoons" which was alluded to in Note 12 of the former paper, are quoted in a work called Se-quo-yah, by George S. Foster, Philadelphia, 1885.

A description of chunkee, as played by the Mandans in the winter time, is given under the name of "billiards" by Henry A. Boller in his Among the Indians, p. 196.

[26] Narrative of Le Moyne, an artist who accompanied the French Expedition to Florida, under Laudonnière, 1564, Translated [by Frederic B. Perkins] from the Latin of De Bry, Boston, 1875. Description of Illustrations, p. 13; the narrative is also given in Hakluyt's Collection of Early Voyages, a third edition with additions. London, 1810, Vol. III, p. 370.

follows: in the middle of an open space is set up a tree some eight or nine fathoms high, with a square frame woven of twigs at the top; this is to be hit with the ball, and he who strikes it first gets a prize." The cage in this game was fixed, and in the illustration given by De Bry, it is evident that the cage could not easily be turned. In this respect this description differs from that given by Lafitau.

Strachey informs us that foot-ball was found in the South. He bears testimony to the honorable spirit in which the game was conducted: "Likewise they have the exercise of foot-ball, in which they only forceably encounter with the foot to carry the ball the one from the other, and spurned yt to the goale with a kind of dexterity and swift-footmanship, which is the honour of yt; but they never strike up one another's heels, as we doe, not accompting that praiseworthie to purchase a goal by such an advantage."

Roger Williams describes this game as it was played among the Narragansetts. His account is relieved from the absurdities which occur in the description given by Wood in "New England's Prospect." "Besides, they have great meetings of foot-ball playing, onely in Summer, towne against towne upon some broad, sandy shoare, free from stones or upon some soft, heathie plot, because of their naked feet, at which they have great stakings, but seldom quarrell."

Colonel Dodge in "Our Wild Indians"[27] records the fact that among the Nez Percés and other western tribes the women are extremely fond of a game of ball similar to our "shinny" or "hockey," and Boller in "Eight Years in the

[27] Our Wild Indians, by Colonel Richard Irving Dodge. Hartford, 1882, p. 344.

Far West,"[28] tells us that he found the young squaws (Minnetarees) "playing a game of ball, resembling shinny or foot-ball, inasmuch as the curved sticks and feet are called into service." A game of ball, similar to the one described by Catlin among the Sioux women, was played by the women whom Kohl met.[29] Two leathern bags stuffed with sand and connected by a thong were substituted for balls.

OTHER GAMES OF CHANCE.

Several different forms of the guessing game as played by the Indians of the northwest coast are described in the former paper. The descriptions referred to in notes on that paper and there credited to "The Northwest Coast," by James G. Swan, will be found in substantially the same form in the "Smithsonian Contributions to Knowledge."[30] The same author has also contributed a description of a game played among the Haidahs[31] which closely resembles the game described by Poole in his "Queen Charlotte Islands" to which reference was made in the former paper. In that description the guess was whether the number of sticks in the hand selected was odd or even. In the game described by Swan, forty or fifty sticks were used, each having some designating mark. One stick was entirely colored and one was entirely plain. The guessing was devoted to picking out the hand in which the plain or the colored sticks were held. The sticks were beautifully

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[28] Among the Indians. Eight Years in the Far West, by Henry A. Boller. Philadelphia, 1868, p. 67.

[29] Kitchi-Gami, Wanderings Round Lake Superior, by J. G. Kohl, London, 1860, p. 90.

[30] The Indians of Cape Flattery, by James G. Swan, Smithsonian Contributions to Knowledge, Vol. XVI, No. 220, p. 44.

[31] The Haidah Indians of Queen Charlotte's Islands, British Columbia, etc., by James G. Swan. Smithsonian Contributions to Knowledge, Vol. XXI, No. 267, p. 8.

rounded and polished. They were put under a heap of bark-fibre, were separated into two piles, wrapped in bark and shifted from hand to hand while still beneath the pile of bark-fibre. They were then exposed in their bark wrappings for the guesser to make his choice.

According to Swan's observations, the Indians north of Vancouver's Island use this style of sticks for gambling. On the other hand, George Gibbs,[32] speaking of the Indians of western Washington and northwestern Oregon, says: "farther down the coast ten highly polished sticks are used instead of disks."

Dr. J. Hammond Trumbull kindly pointed out to me that information concerning Indian games could be obtained from Indian Dictionaries and Vocabularies. In the Abnakis Dictionary of Father Rasles[33] a game is mentioned, which is described as played upon *des espèce de lozanges entrelassées*, by which is meant, I presume, interlaced lozenges. The statement that the *grains* bet upon the game were placed upon the interlaced lozenges would seem to show that the game was played upon a prepared surface with a pattern of this description upon it. As there is no further account of the game, no conclusion can be drawn as to how it was played. Rasles calls another game "chariot" and says the one who makes chariot does not take the *grains*. The only description given of this game, *traîne qui roule* — is too brief to suggest any idea of the method of the play.

In some of the Western dialects, Dr. Trumbull finds mention of "a game of wheels or roulette," and he has furnished me some references taken from the Kalispel (Flat-

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[32] U. S. G. & G. Survey. Contributions to North American Ethnology, Vol. I, p. 206.

[33] The dictionary of Rasles, Rasle, Râle or Ralle—for the name is spelt in each of these ways by different authors — was printed in Vol. I, N. S. Memoirs of the American Academy of Arts and Sciences. Cambridge, 1833. The original MS. is in the Harvard College Library.

head Indian) dictionary, 1879. Names are then given for "playing at wheels," "playing at wheels or circles, *joues à la roulette*," and "the play wheels, *la roulette*."

CONTESTS OF SKILL.

Kohl [34] found among the Lake Superior Indians a contest which consisted in shooting "slipping sticks" along the ice. This is evidently Morgan's "snow snakes" and La Potherie's "*fuseaux.*"

Long [35] says that the "Cahnuaga" (Caughnawaga) boys were expert in trundling hoop, and that some of them drove hoops while others with bows and arrows shot at the hoops while they were in motion. He states that they would "stop the progress of the hoop when going with great velocity, by driving the pointed arrow into its edge."

OTHER AMUSEMENTS OF WOMEN AND CHILDREN.

Strachey,[36] whose pen has furnished a graphic account of ball playing and of straw elsewhere in the same volume, draws a picture of the light-hearted but immodest amusements of the Indian girls, as shown in the conduct of "Pocahontas, a well-featured but wanton yong girle, Powhattan's daughter," who when about eleven or twelve years old would come to the fort and "get the boyes forth with her into the markett place, and make them wheele, falling on their hands, turning up their heeles upwards, whome she would followe, and wheele so herself, naked as she was, all the fort over."

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[34] Kitchi-Gami, p. 90. Rasles describes a similar play among children. "They slide a flat piece of wood along the frozen snow."

Schoolcraft gives representations of these Snow Snakes in plate 78, Vol. II, Indian Tribes. I am indebted to Mr. Albert S. Gatschet of Washington, for information concerning a game played among the Wintún Indians, called Ka-rá which is played by throwing up two disks of wood connected by a string about three inches long. These are to be caught when they come down. Mr. Gatschet refers to Mr. Jeremiah Curtin, Bureau of Ethnology, for his authority.

[35] Voyages and Travels of an Indian Interpreter, p. 53.

[36] History of Travaile into Virginia.

H. M. Brackenridge[37] found a game among the women at the Arikara village, which resembled jack-stones. "Five pebbles are tossed up in [from] a small basket with which they endeavor to catch them again as they fall."

Rasles, under the heading *Joüets des Enfans* gives, in addition to the form of "snow snake" already alluded to, a game the phrases used in which he interprets as follows: *toupie sur la glace*, etc.; *sur la terre; je la fouette.* This description applies to the spinning of something like a top. Blind-man's-buff is also described—"My eyes are blindfolded and I hunt for some one."

In Shea's "Library of American Linguistics", No. X, is a republication of the radical words of the Mohawk Language, etc., by Rev. James Bruyas. "Atnenha," *Noyau* (the stone of a fruit) is given, and to a compound of the word this definition is added: "to play with fruit-stones as women do, throwing them with the hands." Another compound is defined: "to play at platter."

GAMBLING IN GENERAL.

In the former paper I quoted numerous extracts from authors to show the propensity of the natives for immoderate gambling. The writers who have furnished material for this second paper bear similar testimony. Roger Williams says that in their games they would sometimes stake their money, clothes, house, corn, and themselves, if single persons. He adds that they then became weary of their lives and ready to make way with themselves. The scene which he describes in the play-arbour, the fierce frenzy of the gambling spirit, and the solemn shouting of the lookers-on and players, bring before us much the same scene as that described by Father Lalemant in 1639. Winslow, in his

[37] Journal of a Voyage up the river Missouri, p. 149.

"Good Newes from England,"[38] says "they use gaming as much as anywhere and will play away all, even their skin from their backs, yea their wives' skin also, though it may be they are many miles distant from them, as I myself have seen."

Wood in his "New England's Prospect,"[39] besides furnishing the curious descriptions of games which were used by Ogilby, also dwells in another place, upon the propensity of the natives with whom he came in contact, for gaming. "They are so bewitched," he says, "with these two games, that they will lose sometimes all they have, beaver, moose-skins, kettles, wampompeage, mowhackies, hatchets, knives, all is confiscate by these two games."

Daniel Gookin,[40] writing at a later period, adds his testimony as to gambling among the New England Indians in the following words: "They are addicted to gaming; and will, in that vein, play away all they have."

METHODS OF COUNT.

The examination of Indian vocabularies has disclosed several new points concerning the methods of counting the several games.

According to Rasles, the count was sometimes kept by thrusting sticks in the ground. In case of loss, the sticks were removed. This is shown by Indian words used in the games which Rasles interprets respectively: "I thrust

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[38] Good Newes from New England; or a true Relation of things very remarkable at the Plantation of Plimouth in New England, London, 1624—reprinted in Chronicles of the Pilgrim Fathers of the Colony of Plymouth, etc., by Alexander Young, second edition, Boston, 1844, p. 307. Purchas gives an abbreviation of Good Newes, etc., in his Pilgrimes, Vol. IV, Lib. X, Chap. 5. The quotation will be found p. 1859. See also on this point, Morton's New English Canaan, published at Amsterdam, 1637, and reprinted by the Prince Society, Charles Francis Adams, jr., Editor, Boston, 1883, p. 138.

[39] New England's Prospect, Part II, Ch. 14.

[40] Historical Collections of the Indians in New England, etc., by Daniel Gookin. Collections of the Massachusetts Historical Society for the year 1792, Vol. I, p. 153.

a stick in the ground to mark the games ;" "I win a game from him, I place a stick," etc. ; "He takes the mark for a game away from me, he removes a stick, etc ;" "He takes away all my marks, he removes them all, etc."

Rasles speaks of the *ronds* and the *grains* used in the game. The former were evidently the dice,[41] of which descriptions have been given in so many forms in the former paper. Concerning the latter, Rasles in one place gives the same word for them in connection with the game of platter as he gives for the *ronds*, but elsewhere speaks of them as if they were wagered on the game. Referring to the definition of *porcelaine* in Rasles, Dr. Trumbull points out that the *grains* were the beads of wampum. The value at which "Wampampeag" should pass current as money was, at one time, fixed by law in the colony of Massachusetts Bay.[42] It is, therefore, evident that when Rasles represents the *grains* as placed upon interlaced lozenges (*lozanges entrelassées*), he is describing a form of betting where what was practically money was directly put up on the game.[43]

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[41] Defined, according to Dr. Trumbull in the Illinois MS. Dictionary, as follows: "*Fêves pour jouer, comme des dez, noyaux des prunes, corne de cerfs, osselets a jouer.*"

[42] The General Laws and Liberties of the Massachusetts Colony, Cambridge, 1672, p. 154. See also, Code of Laws, Colonial Records of Connecticut, Vol. I, p. 546.

In Perrot's description of Straw, the *grains* spoken of were described as seeds of trees much like apricots. Of these, he says, they took a certain amount representing a gun, a cover, etc. If he had used *grains* in the sense of wampum, there would have been no necessity to describe the stakes as having a representative value. Wampum itself had a distinct value as a circulating medium among many of the tribes. Rasles gives the measure of the different varieties in beaver.

[43] In what I have said concerning the information to be derived from Indian dictionaries, I have tried to make clear the fact that I was indebted to the generous help of Dr. J. Hammond Trumbull. Many of the citations were inaccessible to me and of those which were at my command, no such comprehensive analysis would have been possible without his aid. The development of this part of the subject would have additional value for the reader if I could have copied what he said; but as it was in the form of letters, and not intended for publication, this was impossible.

CONCLUSION.

The foregoing references and quotations are mainly cumulative. They show that the early English explorers and settlers found in New England and Virginia the same games which the French found in Canada, with the addition of foot-ball, of which I have not seen any mention made by the French writers. As this game required for its play a smooth surface, it is not likely that it was played to any extent, except where the flat sandy beaches furnished a ground fitted by nature for the purpose. The game of koho carries lacrosse unmistakably across the continent, although like most of our information concerning Pacific coast games, that which we have concerning this game is too recent to have especial value or significance. The game of chunkee, of which Mr. Henshaw has found evidence that it was formerly played among the Santa Barbara Indians, had already been traced in substantial form west of the Rocky Mountains. From the facts collated in this paper no new inferences can be drawn. Their tendency is merely to corroborate whatever conclusions may be drawn from the former paper.